The Dock and Harbour Authority

No. 372 Vol. XXXII OCTOBER, 1951 Monthly 1s. 6d

Editorial Comments

Fawley Oil Refinery.

In our issue of May last, we published an article reviewing recent oil port developments in various parts of the world, and among the United Kingdom oil ports, reference was briefly made to the new installation at Fawley in Southampton Water.

This new refinery, which forms the subject of our leading article in this issue, was officially opened by the Prime Minister on 14th September last and provides a striking example of the great change which has taken place in British oil policy, as until a few years ago, it was considered more economical to effect the refining of crude oil as near the oilfields as possible, importing the refined product into the United Kingdom.

Now, however, the tendency is to construct large refineries near the oil markets rather than the sources of supply, and for this change in policy there are several reasons, among them being, besides those referred to in the article, the unsettled political situation in the Middle East, which makes the erection of expensive refining plants in that area a venture fraught with hazard and commercially unsound.

The actual site of the new refinery at Fawley has been criticised by some on the grounds of its alleged vulnerability to air-attack in the event of war; also there is the risk of oil pollution. Answers to these objections are surely that the refinery has been built for peacetime production and that for this purpose, it is probable no better site could have been chosen, and secondly, the risk of oil pollution would be the same wherever the refinery is situated, its avoidance being merely a matter of proper precautions carried out in accordance with existing regulations.

Speaking at the opening ceremony, the Prime Minister referred to the interruption of oil supplies from Persia and the desirability of seeking alternative sources of supply which would not increase the dollar cost to this country. Oil supply advisory committees had accordingly been set up both in Britain and the United States to advise the Government. The contribution of the Fawley refinery to the solution of this country's balance of payments problem was of great importance, and the project played an important part in the negotiations last year on the dollar-sterling oil question, which led to an amicable agreement between the Government and the American oil companies. Also, as far as the New Jersey Company is concerned, the dollar costs of its oil would be substantially reduced by the Fawley refinery. Other benefits, having regard to the world shortage of sulphur, will be a not inconsiderable output of that substance as one of the by-products.

From its inception, the whole enterprise has been a fine example of co-operation between Britons and Americans, with effective inter-Government backing. The cost of the project amounted to 37½ million pounds, and it is interesting to note that the bulk of the capital needed came from the reserves of the Esso Company and that two-thirds of this sum was spent in Britain.

The new marine terminal is an important part of the installation, and the principal characteristics of its location are the safe and sheltered anchorage and ample depths of water, while, owing to the double tide in Southampton Water, tankers can manœuvre unaffected by tides or weather conditions or by movement of other shipping.

With regard to the design and construction of the tanker jetty, it will be noted that pre-fabricated caissons are largely used as strong points in the structures and as mooring dolphins, with the decking and pipes supported on hollow cylindrical reinforced concrete piles, pre-cast beams and frames.

Further items of interest are the methods adopted in the construction of the caissons and of their founding on their prepared bases. Due to the necessity of saving timber, staging was largely eliminated, all of the cylindrical piles being handled, pitched, and driven by means of floating craft—no mean feat having regard to the size and weight of the piles. The fender system is also worthy of note, but unfortunately no drawing has been included in the article.

Freight Handling.

On a following page will be found the first instalment of a review of the Report of the Freight Handling Team which studied, during several months of 1950, freight handling methods in the United States of America.

It is generally acknowledged that the Americans are pre-eminent in the fields of applied research and technology. In regard to basic science on the other hand, they have not yet reached a comparable degree of prominence. Their position in this respect, however, is likely to be largely rectified by the National Science Foundation formed by an Act of Congress in 1950, which is authorized to develop and encourage the pursuit of a national policy in respect to basic research and education in the sciences, with which is included the social sciences, and to co-operate in international scientific research activities.

Where America has perhaps emphasised technological development at the expense of scientific research, the United Kingdom, by long and traditional emphasis on basic or pure research, has attained a balance in the opposite direction. Thus each country may have much to learn from the other.

This Journal has consistently advocated the free exchange of knowledge of port organization and methods of port working. We therefore welcome the present Report which, in our view, should be studied by all interested or engaged in freight handling. We also are in entire agreement with the final Recommendation that American transport representatives should, on their part,

Editorial Comments—continued

participate in a survey of British Ports, as such a study could not fail to assist both the American and British port and transport industries.

Judging from the Report, the most important aspect of mechanisation in the docks of this country is the attitude of labour towards the use of mechanical handling appliances. In this respect, there are some outstanding differences between American and British conditions, as can be seen from the fact that in the United States dock labour is remunerated at much higher wage levels on a time basis, bonus or piece-work rates being viewed by both employer and employee with disfavour. There is also a marked machine consciousness among American dockers who, under the above system of payment, naturally favour any reduction in physical fatigue.

The American employer is therefore much more favourably placed economically compared with his British counterpart, who more often than not gains nothing by mechanisation and may even cause a complete stoppage of work if he presses for a reduction in tonnage rates, or in the number of men per gang.

Another factor which has a bearing on mechanisation is that, in the United States, dock labour is still casual and greatly exceeds the demand. We certainly do not advocate so retrograde a step as a return to casual conditions of labour in this country, and we wholeheartedly endorse the Team's recommendations in respect to more energetic co-operation between management and labour, the development by the trade-unions of machine-consciousness amongst their members, and the value of giving the workers practical demonstrations of the benefits of mechanisation, and visual evidence of the absorption of redundant workers into other gangs or parts of the industry.

With regard to the actual appliances used in terminals, it seems that much of the equipment seen in American Ports was not new to the Team, the only apparent difference being the greater use that is made of machines in the States. The Report, however, describes several new types of plant which embody important innovations, and readers will examine with interest the Team's remarks concerning the use of pallets and containers.

It will be observed that the Report recommends that consideration should be given to the installation of the "house fall" system as an alternative to quay cranes in certain circumstances. This is a sound suggestion in the case of harbours with an inconsiderable tidal range, but it is significant that at Boston in America, new marginal quays which are being constructed in preference to the more usual "finger" piers may also be equipped with quay-cranes instead of relying entirely upon ships' gear as hitherto.

Review of Trade Harbours.

Having regard to the public interest that has been shown in the progress of the statutory review of trade harbours, dealt with in a section of the Third Annual Report of the British Transport Commission, which was reviewed in our issue of August last, the Reports of the Docks and Inland Waterways Executive for the period 1948-50 have now been published in book form, and a few excerpts and comments respecting the more important ports and port areas are given on another page. The full reports contain much authoritative information upon the general and physical background, trade constitution and financial features of British Ports, apart from the conclusions arrived at, and the recommendations of the Executive.

Although it was not to be expected that full agreement with some of the Executive's findings would be obtained, there is, nevertheless, considerable ground for the impression that they are the result of careful consideration. Indeed, bearing in mind that the duties imposed by Section 3 of the Transport Act upon the Transport Commission, include the promotion of an efficient, adequate, economical and properly integrated system of public inland transport and port facilities in the United Kingdom, many of the conclusions arrived at seem inevitable.

Generally speaking, ports primarily serve the needs of the population and industries in their immediate vicinity, but the wider the area they serve, the more they become of national, rather than of local concern, for their importance then lies in their being an effective link in a chain of transport. In these days of economic stringency, it is clear that a purely parochial or competitive outlook is entirely misplaced, if it engenders uneconomic charges, or a policy of capital expenditure on dock and harbour facilities designed to attract traffic from other ports.

While the control and management of a port, or group of ports, is a matter best accomplished by those with intimate local knowledge of all the details and ramifications of the trade and working, the composition of the governing body should be based upon principles affording proper representation of all parties actively interested in the port, a balance being maintained between sectional trade interests and public interests.

Under the competitive conditions of the past, ports in this country were undoubtedly keenly alive to the necessity for reducing operating costs by efficient dock practice, and it may be asked what alternative, if any, can be offered in the future to replace this incentive, so that the efficiency of the ports may be maintained. The Executive recorded, in the case of Bristol, the local pride and interest which was displayed by all parties in the well-being and efficiency of the port, and this seems to be an achievement worthy of emulation from whatever angle it is viewed.

The subject of port labour problems was specially mentioned by the Executive in the cases of London, Liverpool and Manchester, and at these ports the recent labour disturbances was stated to be a most disturbing factor. There are points of similarity in several directions between the first two ports just mentioned, and perhaps the most important, having a bearing on labour relations, is the large number of employers of labour in the ports, which entails a diversity of working conditions and agreements and generally tends to lower the level of efficiency.

It is interesting to note that in the case of Liverpool, it has been suggested that there should be an expansion of overside lighterage work, involving a re-establishment of waterside warehouse accommodation. While discharge into lighters as well as to quays, tends to quicken the turn-round of shipping, it seems that, unless both the waterside wharves and the control of lighterage are vested in the Harbour Board, the change will only result in competition between individual employers and the Board—a disability from which the Port of London Authority is suffering.

With regard to increased mechanisation, it appears from the Review that, generally speaking, achievements at the ports in this respect have not been at all spectacular. The reasons may be variously ascribed to physical disabilities of some quays, the large numbers of port operators and/or wharfingers (many in a small way of business) and thirdly, the universally uncompromising attitude of the dockers towards the use of labour-aiding machines.

In connection with both the Freight Handling Report and the Review of the Executive, it is appropriate to call attention to an article on a following page which describes the operation of a Mechanical Handling Equipment Pool in Australia. It is unfortunate that the recommendations recently made by the Working Party on Increased Mechanisation, for the introduction of an interchange system and a hiring pool, have not been adopted at the Port of London, where such a system would seem to be peculiarly applicable. The reasons for this, mentioned by the Executive, are by no means unsurmountable, and it is to be hoped that a full exploration of the proposal will be continued to a satisfactory conclusion.

Increase in Subscription Rates

The Publishers of "The Dock and Harbour Authority" regret to announce that, owing to substantial increases in the price of paper, printing, postages and overall production costs, it has been found necessary, for the first time since the Journal was founded in 1920, to increase the selling price to 2s. per copy plus 4d. postage. The annual subscription will be 26s. od., including postage to any part of the world, and the new charges will take effect as from 1st January, 1952. Current subscriptions will continue at the old rate until due for renewal.

The New Oil Refinery at Fawley

With Particular Reference to the Marine Terminal Facilities

(specially contributed)

THE OIL INDUSTRY in Great Britain to-day is passing through the most important period of development and expansion in its history. For out of the old industry which before the war was mainly engaged in marketing refined petroleum products obtained from overseas, a vast new one is emerging, namely that of refining imported crude oil on a scale large enough to satisfy entirely the home demand.

This refinery expansion programme represents the investment of some £125,000,000 and the new refineries now being built will, when completed, raise the country's total refined petroleum production to about 20,000,000 tons a year in 1953, as compared with 3,500,000 tons in 1948.

In order that the significance of these new developments to the economy of the United Kingdom may be appreciated fully, certain fundamental factors which have dominated the world oil picture, particularly since the war, must be considered.

First of all, an enormous increase has taken place in the total consumption of petroleum, not only in the United Kingdom but in the whole world. World consumption rose from 265,000,000 tons in 1938 to approximately 500,000,000 tons in 1950, and for the United Kingdom, the figures were 10,000,000 tons in 1938, as against 18,000,000 tons in 1950. The United States alone is using more oil to-day than was the whole world twelve years ago, and the future trend of consumption in all countries is likely to be steadily upward.

This spectacular increase in American consumption created a major oil supply problem for European countries because, before the war, Europe relied on the United States and Caribbean sources for most of her oil imports.

Again, as a result of this trend, world refinery capacity was totally inadequate for handling the much greater quantities of crude oil being produced from the earth to meet the growing demand for petroleum products—products that are essential both to industrial progress and to improved standards of comfort and living.

Furthermore, the grave shortage of hard currencies throughout Europe, and especially in Great Britain, made it imperative for our country to restrict drastically those imports which cost dollars.

It is for these principal reasons that the Middle East, rather than the Western Hemisphere, has become Britain's chief source of crude oil. Fortunately, developments have occurred there at a breathtaking speed, and oil from that region can be purchased predominantly for sterling payment. The fact that Kuwait, from which virtually no oil was obtained in 1938, last year produced well over 17,000,000 tons gives some idea of the remarkably high rate of discovery and production that has occurred in the Middle East. Furthermore, in Saudi Arabia only 67,000 tons of crude were produced in 1938, compared with 23,000,000 tons in 1950. This, in an area where the local consumption is very low, means that a substantial proportion of the Middle East crude is available for export to oil-thirsty markets, and in particular to Europe. But if the crude oil from the Middle East is to be of any use to mankind, it must be refined, a fact which brings us back once again to the need for greatly increased refinery capacity, not only in the United Kingdom but on the Continent of Europe as well.

The oil companies in Great Britain have solved this critical problem by building a new refinery industry at home, thus reversing the long-standing policy of refining at the source of production.

The Planning of Fawley Refinery.

By far the largest single project in this refinery development programme is the Esso Petroleum Company's new refinery at Fawley, near Southampton, costing more than £37,500,000. When completed it will be the largest oil refinery in Europe, and it will produce some 6,000,000 tons of petroleum products a year, including a daily output of 1,000,000 gallons of high-quality motor spirit.

The decision to build a refinery of this size was taken only after a very close study had been made, both of the nation's and the Company's anticipated petroleum requirements for many years to come. On completion it will supply immediately the whole of the Esso Petroleum Company's needs, amounting to rather more than a quarter of the total United Kingdom demand. It will be exceeded in size only by a few of the world's largest refineries.

No E.C.A. dollars are involved in the financing of Fawley. It is a private enterprise project which fits in with the general picture of European recovery in that it is a big dollar saver, the savings being estimated at over 2,000,000 dollars a week.

When it was decided by the Company to build a new refinery, a number of alternative sites in widely separated parts of the country were carefully examined, but Fawley was recommended as the most suitable.

This choice was to some extent prompted by the fact that the building of the new refinery at Fawley would involve extending the Company's older existing refinery there, thus permitting a progressive and more rapid utilisation of the new facilities. But it should be emphasised that, although the presence of the older refinery contributed numerous advantages in favour of building the new one on adjoining land, this factor was by no means decisive. Rather was it felt that most of the reasons for selecting Fawley as the site of the original refinery remained undeniably sound and carried great weight in connection with the requirements of modern refining technique, the availability of skilled labour and marketing economics. The structure and elevation of the land offered the quickest and cheapest development for refinery construction, and the location is ideal for the distribution, throughout the whole of the United Kingdom, of the large volume of petroleum products which Fawley will produce.

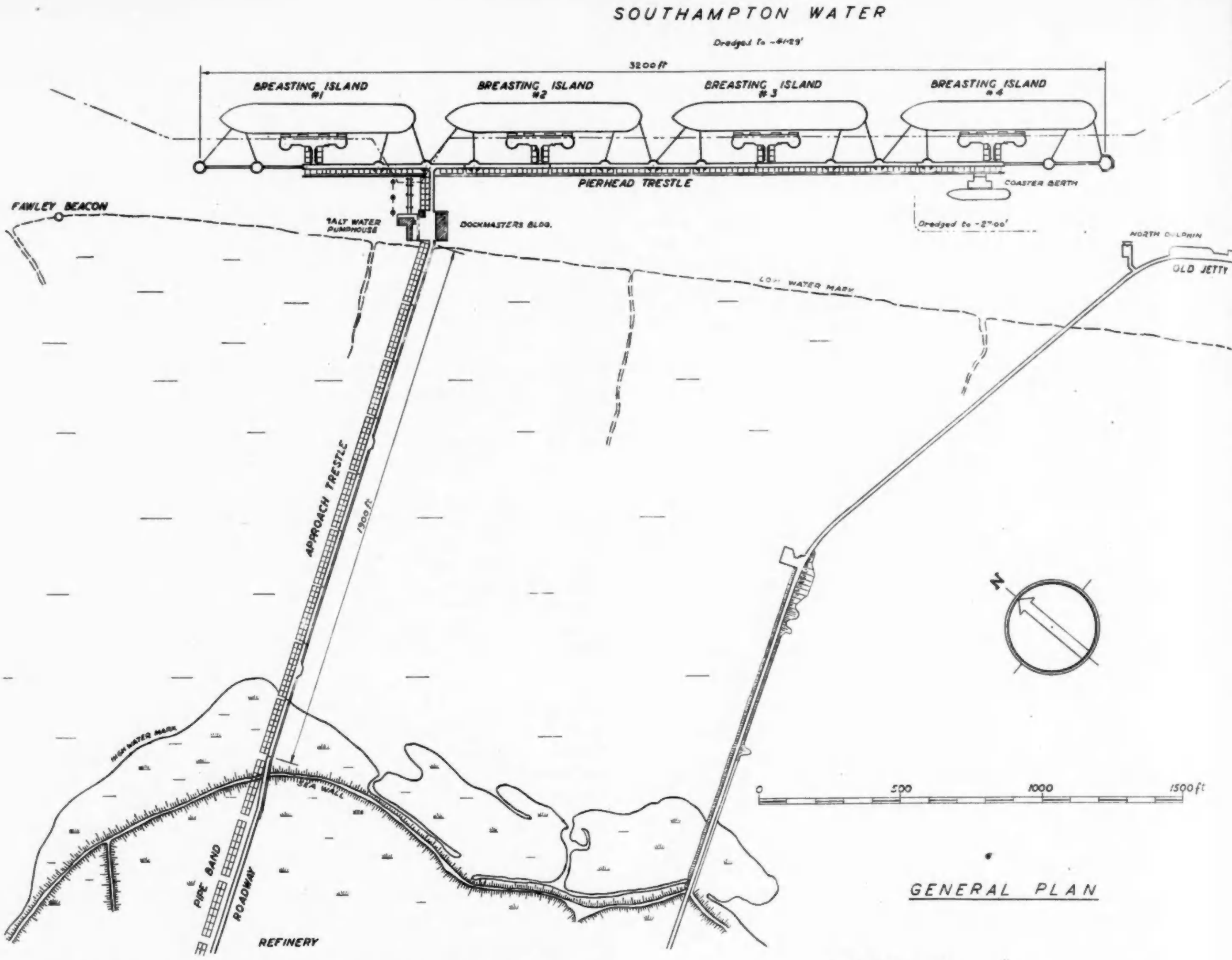
Among the important factors that had to be considered were shipping and berthing facilities. For at least one large ocean tanker will dicharge crude oil every day at Fawley, and others will be constantly leaving with finished products for the Company's important ocean terminals around the coast of Britain.

Southampton is one of the finest harbours in the world, and navigational and marine conditions at Fawley are ideal for all ocean, coastal and local tanker operations. The unique double tide and the slow-moving current of Southampton Water enable fully-laden ocean tankers to swing, berth, and unberth at any time of the day or night. In an emergency, tankers could quit berth at any stage of the tide. The berthing site is fronted by about 2,500 feet of open navigable water, and is isolated from all other shipping activities. This isolation provides an important safety factor in undertaking the large number of concentrated tanker operations involved. An ocean tanker jetty already exists at Fawley and ample foreshore space is available for erecting four more similar berths, as well as accommodation for coasters, bunkering vessels and barges.

Of all feasible refinery sites, Fawley is also the most economical location in relation to the crude oil supplies of the Middle East and to the oil pipelines at the eastern end of the Mediterranean. Furthermore, it offers the shortest haul for the delivery of products to the largest consuming area, namely London, and the best outlet for locally consumed fuel products.

Although the main contract for the procurement of the major units and for their erection has been placed with the Foster Wheeler Corporation in America, the actual work is being executed by Foster Wheeler Limited, a British affiliated company employing British labour, and who have placed very large sub-contracts in the United Kingdom, amounting in value to about two-thirds of the total expenditure on the refinery.

The administrative buildings have been designed by the architects, Messrs. Lanchester and Lodge, and will be constructed throughout by British builders. Also, the entire contract for the



GENERAL PLAN

extensive new harbour facilities has been placed with a British firm, Messrs. Christiani and Nielsen, Ltd. of London.

It has, however, been found necessary to obtain the major refinery units, such as the catalytic cracking plant, the pipe stills, the Edeleanu plant and some of the feed plant from the United States of America. In some instances it would not have been possible to get certain plant items from anywhere else except America, whose petroleum equipment manufacturers alone have the capacity for, and special experience of, its production.

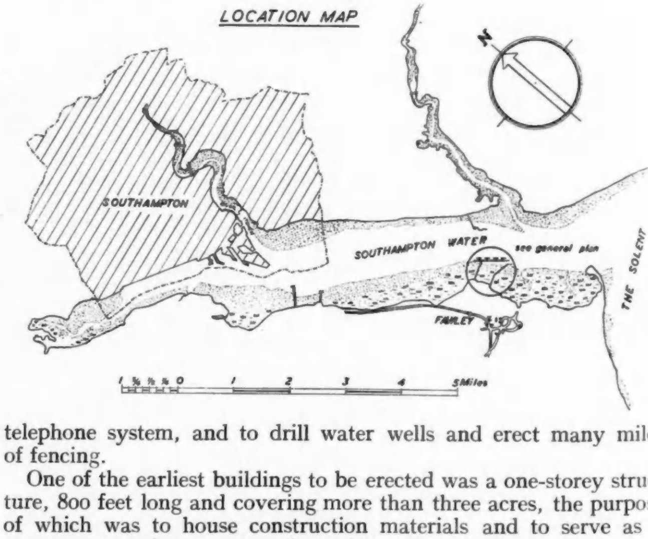
Phases of Construction.

Up to now the world's greatest refineries have never sprung into existence suddenly. They have begun as relatively small operations which have gradually been extended as markets have grown.

Fawley, however, has been built almost in its entirety, for its new units will have a capacity over six times greater than that of the present refinery. Barely two years after the ground was first broken, this immense complex of pipes, tanks, stills, furnaces, and towers together with the delicate apparatus enabling the whole to be controlled with almost laboratory precision, began to pulse with the flow of oil. To achieve this, millions of cubic feet of earth have had to be excavated and hundreds of thousands of tons of materials assembled on the site at the moment when they have been required. Yet so carefully was the operation planned and so well has it been executed that the contractors describe Fawley as the smoothest running job, for its size, they have ever tackled.

The first steps were to clear and level the 450-acre site, to construct temporary roads, to lay down the entire railway system amounting to several miles of track, to instal a field plant and a telephone system, and to drill water wells and erect many miles of fencing.

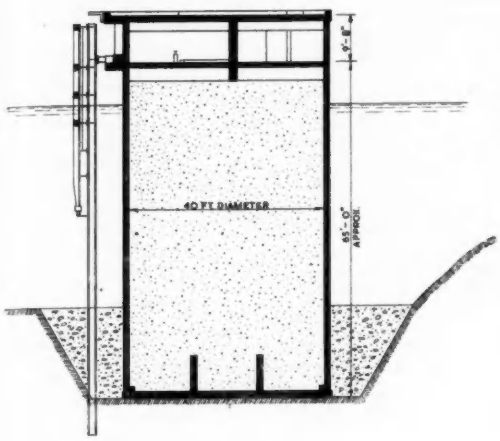
LOCATION MAP



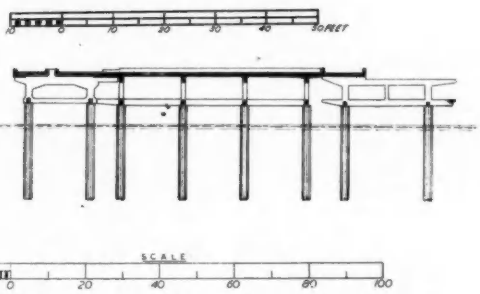
One of the earliest buildings to be erected was a one-storey structure, 800 feet long and covering more than three acres, the purpose of which was to house construction materials and to serve as a permanent maintenance and machine shop and warehouse. It contains travelling cranes, the latest types of machine tools, and modern systems of lighting and ventilation, designed for the comfort of those who work there and to give maximum efficiency all round.

A construction camp on the site to house 750 workmen was

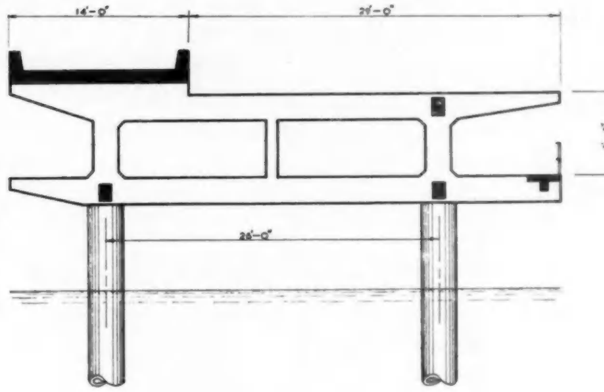
New Oil Refinery at Fawley—continued



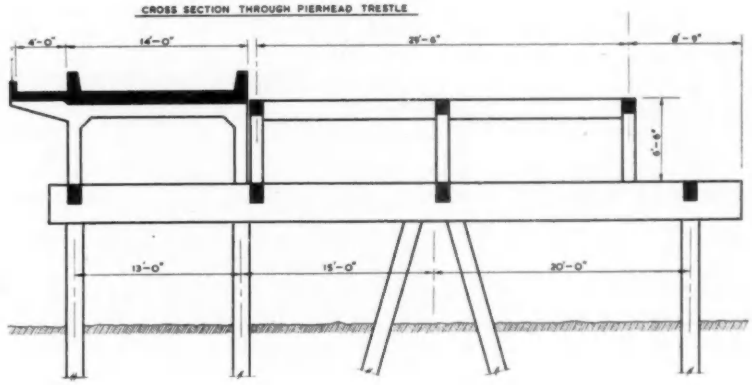
CROSS SECTION THROUGH STRONG POINT OF BREASTING ISLAND



Longitudinal Section of Trestle connecting Island to Pierhead Trestle.



CROSS SECTION THROUGH PIERHEAD TRESTLE



CROSS SECTION THROUGH APPROACH

specially built, and canteen and club facilities were provided for the labour force, a large proportion of which travelled by rail and bus daily from Southampton and the surrounding countryside.

To provide the vast quantities of concrete for the deep foundations, a batch mixing plant with an output rate of 140 cubic yards of concrete an hour, was set up in the first few months. It is one of the largest in the world and had turned out at least 100,000 cubic yards of concrete by the time the refinery was completed.

The second and main phase embraced the whole operation of installing the main refinery units. For this purpose three guy derricks were erected; the largest, 265 feet high with a boom 140 feet long, operated by a steam engine, had a lifting capacity rated at 100 tons. A typical example of the type and size of equipment which goes into a modern refinery is the Debutaniser Tower, 100 feet high and weighing 135 tons, which arrived in one piece at the site by road from Southampton. This tower, which is only part of the catalytic cracking plant, had to be lifted into a vertical position by means of derricks.

Another important aspect of this phase was the construction of the new marine terminal, consisting of a jetty 3,200 feet long, with berthing facilities and accommodation for four 39,000-ton ocean tankers. This involved extensive pile driving into the bed of Southampton Water as well as across a stretch of marsh to take a causeway 5,000 feet long for the approach and pipe bank, through which both the incoming crude oil and the outgoing finished products will pass.

The third and final phase concerned the great mass of detail which the completion of any large industrial project entails when all the internal work in the buildings has to be done by electricians, plumbers, carpenters, plasterers, painters, and many other craftsmen.

A very important aspect of the construction of the refinery was to ensure that it was in itself not unsightly and that the natural amenities of the beautiful countryside around Fawley, and of Southampton Water were preserved. The Company consulted with some thirty local committees on the best means of doing this, and, as a result of these discussions, it was agreed that the administration buildings should be set within wide lawns, and a carefully planned belt of trees and flowering shrubs will screen the refinery from the road on the landward side.

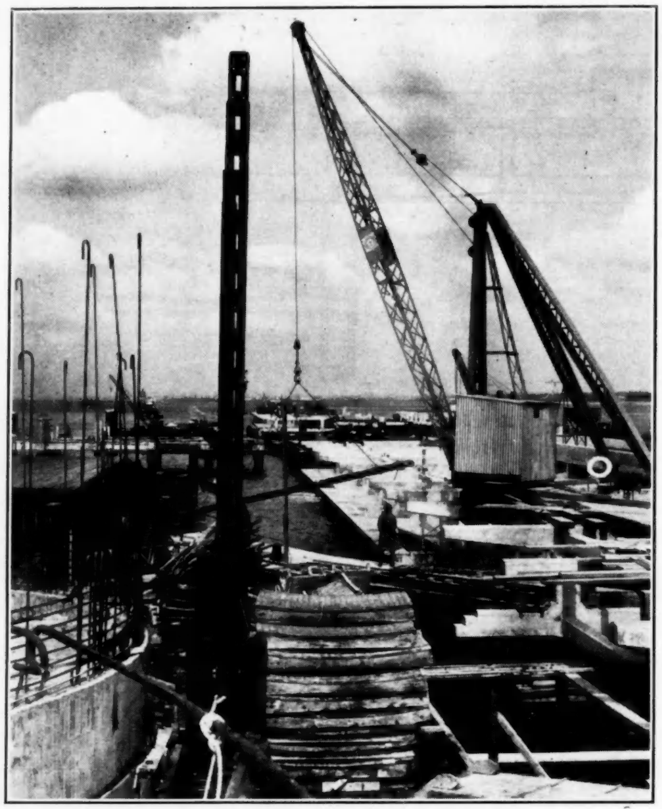
Stringent anti-pollution features have been incorporated throughout. All waste water will be passed through oil separators before discharge, and air pollution will be controlled by burning waste gases as fuel in the refinery furnaces. These and many other means have been adopted, for the Company regards it as essential that the new refinery should cause the minimum interference to the serenity and the natural beauty of its surroundings.

GENERAL DESCRIPTION OF THE MARINE TERMINAL

The marine terminal at Fawley comprises principally an approach nearly 2,000-ft. long and a pierhead 3,200-ft. long. The general arrangement and main details and dimensions are shown on the drawings reproduced. The general arrangement was planned by the Standard Oil Development Company, who also designed the approach. The detailed design of the jetty and the adjoining pumphouse area is by Messrs. Christiani and Nielsen Ltd., who also constructed the approach, the pierhead, and the pumphouse area. The buildings and equipment, including pumps, pipes, and hose-handling structures, were designed and installed by others.

The pierhead accommodates four tankers of up to 39,000 tons and a maximum length of about 700-ft., requiring a minimum depth of water of 34-ft. The principal parts are four berthing islands approximately parallel to the coast and spaced at 800-ft. centre to centre; a pier head trestle 2,470-ft. long parallel to, and

New Oil Refinery at Fawley—continued



Precast frames in main jetty, showing also on the left foreground, the first stage of caisson construction.

130-ft. behind the front of the berthing islands; four trestles connecting the berthing islands to the pierhead trestle; two dolphins at each end of the pierhead trestle; the pumphouse area at the outer end of the approach, comprising a parking area, a dockmaster's building, a substation and transformer platform, and a pumphouse from which salt water is pumped to the refinery; a berth for coasting ships 250-ft. long and three landings for launches on the landward side of the pierhead.

The major portions of the structures on the pierhead and the pumphouse area are supported on hollow cylindrical piles, and the approach is on rectangular piles. Sand-filled cylindrical caissons are provided as strong-points in the pier to resist the large horizontal forces due to the mooring and berthing of vessels. Bollards are provided on each of the caissons, the south dolphin and on the deck between the berthing island caissons.

The cylindrical piles have an outside diameter of 32-in., an inside diameter of 20½-in., and a wall 5¾-in. thick, and are designed to resist vertical loads and moderate horizontal forces such as wind pressure on the trestles. Tests show that the piles can be assumed to be fixed about 10-ft. below the sea bed.

The cylindrical caissons, the heights of which are from 60-ft. 6-in. to 67-ft., have bottom slabs stiffened by beams. Two sizes of caissons are used, one of 36-ft. outside diameter with 9-in. walls, and one of 40-ft. diameter with 10-in. walls. The cylindrical form of the walls is the most economical as it results in the smallest bending moments from the filling.

Berthing Islands and Connecting Trestles.

The berthing islands have two 40-ft. caissons placed at 196-ft. centres with a trestle on cylinders between them, and another trestle connects the island to the pierhead trestle. A deck-slab generally 12-in. thick covers the caissons and trestles between the caissons at the same level as the road on the connecting trestle. The pipes are carried on beams below the deck. For a width of 3-ft. 10½-in. at each side the slab is 15-in. thick. An expansion joint is provided between the connecting trestle and the pierhead trestle, but the berthing island and the connecting trestle are a single structure without joints, most of the horizontal forces on them being resisted by the caissons. Calculation showed that thermal expansion and contraction of the deck of the berthing islands will not cause any large additional stresses, as the caissons can deflect due to elastic deformation of the sea bed.

The frames of the berthing island trestle are of precast concrete and each is supported on two cylinders. They are at 20-ft. centres in the three central spans and at 16-ft. centres in the three spans at each end. Each frame in the connecting trestle comprises two precast beams supported on four cylinders at 20-ft. centres, the frames also being at 20-ft. centres, beams support the pipes, and cast-in-situ frames, between the two central cylinders, carry the road. Connection is made to the frames of the berthing islands by four precast struts, one above each row of cylinders.

A lower slab in each caisson acts as a cover to the gravel filling and stiffens the walls against the forces from the fenders as the spring buffers are attached at this level. The wall of the caisson between the lower slab and the top deck is cast-in-situ and forms a circular space between the two slabs. Access is provided to the space by openings in the wall.

Four fenders are placed on the front of each berthing island, including two on the caissons. Each fender consists of a heavy welded steel frame faced with 12-in. square greenheart rubbing strips supported on 24-in. x 12-in. steel piles. The frames are assembled away from the site and lowered as a whole in front of the piles, to which they are connected by welding above water and by bolts below water. Coil-spring buffers are placed between the piles and the concrete structure. The rubbing strips extend from the underside of the deck to about 15-ft. below low water.

Pierhead Trestle.

The pierhead trestle is about 2,470-ft. long and connects the berthing islands with the approach. The overhanging ends of the transverse beams at two levels carry pipes. An expansion joint is provided between the pierhead trestle and the approach, and the pierhead trestle is divided by expansion joints into sections from 230 to 300-ft. in length. There is an expansion joint in each space between the caissons, so that each section is tied to one caisson only. The caissons are 36-ft. in diameter.

Each frame of the trestle was precast and is supported on two cylinders. The frames, which are generally at 20-ft. centres, resist the wind forces acting at right-angles to the axis of the trestle, so that bending moments are produced on the cylinders. Forces parallel to the axis of the trestle, such as those due to friction between the pipes and their supporting frames caused by expansion and contraction, are transmitted to the caissons through the struts and the road slab, and the reinforcement in the struts is therefore greatest at the caissons and least at the expansion joints.

The caissons are designed to resist the pulls on the bollards and the forces carried over from the part of the trestle to which the caisson is connected. The pipes are anchored to the concrete structure at some of the caissons, and forces due to the anchorage are thereby added to the forces previously mentioned.

Dolphins.

The two dolphins at the northern end and one dolphin at the southern end of the pierhead trestle are more or less of the same design, being a 36-ft. diameter caisson covered by a concrete deck. A bollard on the seaward side of the caisson is anchored to a block of concrete under the deck. The other dolphin at the southern end is is a turning dolphin of special design, being a 40-ft. diameter caisson with a concrete deck, two bollards on the seaward side, and a large fender comprising five spring-fenders similar to those on the berthing islands.

Berth for Coasting Vessels.

The deck of the berth for coasting vessels on the landward side of the pierhead trestle is supported on a 36-ft. caisson and six cylinders filled with concrete. A fender of 16-in. by 12-in. steel

New Oil Refinery at Fawley—continued

piles with 12-in. by 12-in. steel walings and rubbing strips of greenheart is fixed along the front, which is 86-ft. long.

Substructure of the Pumphouse Area.

The dockmaster's building, which is 94-ft. by 33-ft. and of two stories, is on a concrete deck alongside the road. The pipes from the approach are carried under the deck of the parking area and on the outer end of the approach to the pierhead trestle. The substructure of the dockmaster's building, the parking area, and the outer end of the approach is separated by expansion joints from the pierhead trestle, the approach, the substation, and the pumphouse, and is supported on hollow cylindrical piles. Large capping beams are placed at the lower level on the hollow piles, which with the beams form a series of rigid frames. The decks are supported on 16-in. square columns extending above every hollow pile, extra columns between the piles being provided under the beams carrying the walls of the dockmaster's building.

The pumphouse is supported directly on hollow piles, and the decks of the substation and transformer platform are carried on columns supported on piles. The basin below the deck of the pumphouse and the forebay is enclosed by steel sheet pile walls. Water enters the forebay through a concrete flume extending to the pierhead trestle.

The concrete flume is 130-ft. long, 10-ft. wide and 6-ft. high. It is supported on four frames each comprising two hollow piles and two precast beams one below and one above the flume. The flume was cast in a floating dock, the ends were closed by timber bulkheads, and it was towed to the site.

The Approach.

The approach is 1,900-ft. long and is divided by expansion joints into sections of 200-ft. The structure comprises 99 trestles, generally at 20-ft. centres, and a reinforced concrete superstructure. Each trestle consists of 14-in. by 16-in. reinforced concrete piles varying in length from 55-ft. to 85-ft. For the first 800-ft. there are four vertical piles in each trestle, the anchor trestles having three vertical piles and 18 inclined piles. Beyond 800-ft. there are five piles, of which two are inclined, in an ordinary trestle. The piles are connected transversely at the top by a cast-in-situ capping beam. Strutting longitudinally is effected by precast reinforced concrete beams connected at each end to the capping beams.

Design Data.

Concrete of two qualities was used, one having a strength at 28 days of 3,500 lb. per square inch for members above water, and the other having a strength af 4,500 lb. per square inch for members below water, such as the cylinders, piles, the walls and bottoms of the caissons, and the flume. The thickness of concrete over the main reinforcement is at least 2½-in. below water and at least 2-in. above water. The working compressive stress in concrete of the greater strength is 1,750 lb. per square inch and the shearing stress 105 lb. per square inch; the corresponding stresses for concrete of the lower strength are 1,350 lb. per square inch and 90 lb. per square inch.

The deck of the parking area, the berthing islands, and roads are designed for an imposed load of 300 lb. per square foot. Alternatively the live load on the parking area is a lorry of 40,000 lb. gross weight plus 30 per cent. for impact, and on the road on the pierhead trestle a lorry of 20,000 lb. gross weight. The gangways are designed for a live load of 100 lb. per square foot. As previously mentioned, the structures are also designed to carry the pipes and resist the frictional forces due to the expansion and contraction of the pipes.

The pressure of the wind is assumed to be 25 lb. per square foot, the exposed area being assumed to extend 6.5-ft. above the roads.

The pulls from hawsers is assumed to be 60 tons on each bollard. The fenders on the berthing islands are designed to withstand the forces imposed by the berthing of 39,000-ton tankers.

The working tensile stress in mild steel bars is 18,000 lb. per square inch in the main reinforcement in beams and 16,000 lb. per square inch in reinforcement resisting shearing force. The compressive stress in reinforcement in columns is 14,000 lb. per square inch.

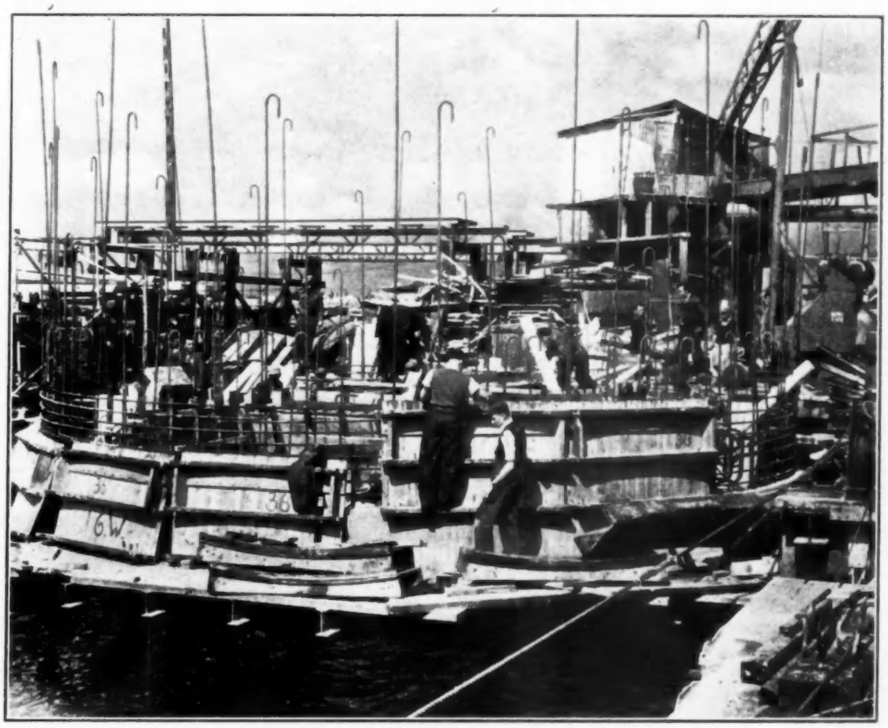
CONSTRUCTION DETAILS OF THE MARINE TERMINAL

Planning the construction as well as the design of the Marine Terminal has been greatly influenced by the necessity of reducing the use of timber for temporary work to an absolute minimum. This has meant that much work, which would be done normally from a staging, has had to be done in another manner, not necessarily more economical.

From the description of the design, it will be seen that the works comprise a considerable number of different structures, requiring a great variety of construction equipment for their execution.

The works were naturally divided into sections, each being under the supervision of a sectional engineer with assistants and a general foreman. These sections were:

1. **Casting Yard,** in which all piles and all precast members of the superstructure were fabricated.
2. **Approach,** 1,900-ft. long, from the sea wall (approx. the high-water line) to the Pumphouse Area.
3. **Pumphouse Area,** comprising substructure for dockmaster's building, parking area, sub-station No. 8, pumphouse and approach between parking area and pierhead trestle.
4. **Piling with Floating Piling Plant** and supervision of dredging done by sub-contract.
5. **Construction and Placing of Reinforced Concrete Caissons** forming the substructure for the dolphins embodied as strong points in the pierhead trestle and breasting islands, or used as mooring dolphins.



Another view of the first stage of caisson construction.

New Oil Refinery at Fawley—*continued*

6. Superstructure in Pierhead Trestle and Breasting Islands.

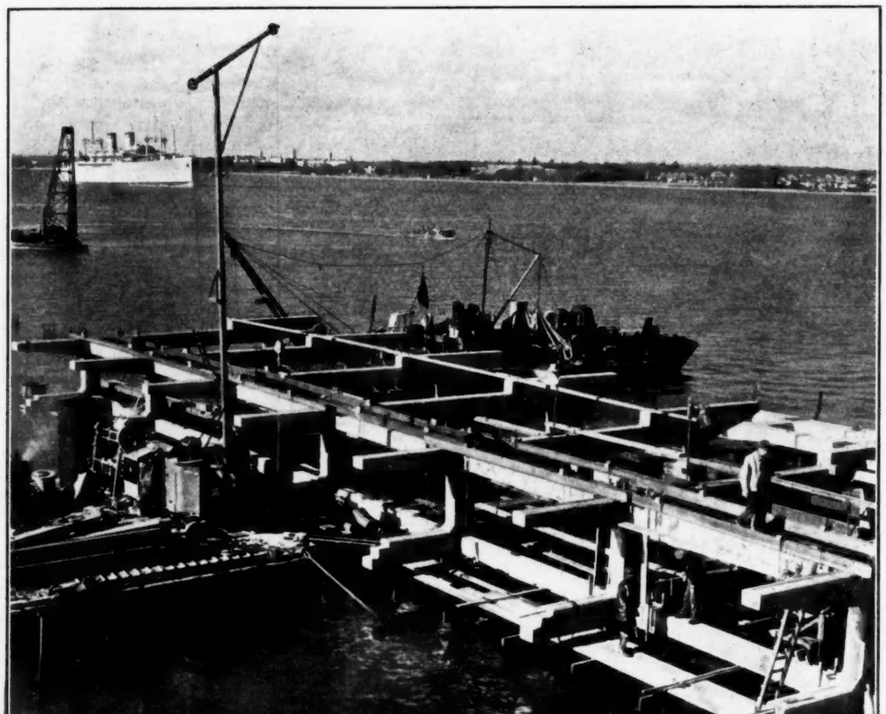
In addition to the actual contruction section, there were the following auxiliary sections:

(a) Workshop and Plant Maintenance Section; (b) Transport section, including platelaying gang and railway maintenance, and (c) Marine Section.

The local conditions were unfortunately such that the casting yard could not be placed immediately above the highwater line, but had to be placed 1,000 yards inland.

1. Casting Yard.

Since the approach from the sea wall to the pierhead trestle is 2,300-ft. long, and the frontage of the works from south to north dophin 3,200-ft., it will be understood that the construction involved a considerable transport problem. For this it was decided to use a 3-ft. gauge railway having several sidings in the casting yard, single track to the sea wall, here branching out with some sidings and continuing with double track on the transport bridge beyond the sea wall.



Work in progress at Fawley. Assembly of precast frames in main Jetty which will carry pipes at two levels of the frame and a roadway on right.

A main-line siding led into the material storage yard located alongside the casting yard, and the 3-ft. gauge railway had a siding running parallel to the main-line siding.

The total length of 3-ft. gauge track was over two miles, and the rolling stock comprised four 5-ton locomotives, one 3-ton locomotive, twenty-four $1\frac{1}{2}$ cu. yd. tipping skips and a variety of bogies for transport of piles, precast members, reinforcement, etc.

It has been mentioned above that, beyond the sea wall, the railway was carried by a transport bridge. This bridge was located downstream (south) from the approach. The two tracks on the transport bridge were laid at 15-ft. centre to centre with a 6-ft. wide gangway between them. The bridge was supported on pile trestles 20-ft. centre to centre with two 12-in. x 12-in. timber piles in each trestle. There was no great difference in the length of the piles from one end of the transport bridge to the other, the length being about 70-ft.

The piles were driven with a specially made cantilever pile-frame with two leaders, one for each row of piles, using a 2-ton monkey.

The transport bridge extended out to the shore side of the pierhead trestle, and near the end it had branches leading to a berth for loading concrete materials, a berth for loading cylinder piles, frames, etc. on to barges, and a construction yard for caissons. The end of the transport bridge also carried offices, stores, and canteens, and altogether about 420 timber piles 12-in. x 12-in. by about 70-ft. long were driven to support the temporary structure.

It will be seen that the railway connected directly with a small portion of the works only. It is further worth mentioning that the level of the transport bridge is +9.5 whereas the level of the deck of the pierhead trestle and the breasting islands is +17.3. In many instances, it was therefore necessary to arrange for further lifting and distribution. How this was done, will be mentioned later.

The total amount of traffic carried by the railway was:

637 sq. piles 14-in. x 16-in., about 75-ft. long.
503 cylinder piles 32-in. diam., 75-ft. long.
170 precast frames weighing up to 18 tons.
1,000 precast struts and gangways.
10,000 cu. yds. concrete.

The bulk of the transport was made over a period of 10 months.

On account of its importance, the transport problem has been mentioned in some detail, although it was not a direct constructional problem.

In the following, construction plant will be described in some cases, and construction methods in others, which ever will be the most informative. Where the construction offers no special features, no detailed description will be given.

Concrete to the works was to a very great extent supplied from a batching plant operated by the contractors for the refinery proper. It was in this case delivered in specially constructed trucks carrying 3 cu. yds. at a time. Concrete from this source was either delivered to the point of application in the casting yard, or to a point at the sea wall from where it was transported by rail.

Concrete was also mixed on the site. There was a stand-by mixer in the casting yard, a mixing plant at the sea wall, a mixing plant in the construction yard for caissons, and two floating concreting plants.

The plant in the yard comprised two 4-ton mobile cranes, 2 pairs of gantries with 48-ft. span and carrying 15 tons chain blocks, a boiler for heating during frost, sundry equipment for transport of concrete, 115 cu. ft. compressor for cleaning out forms and other use, power-driven bar benders and welding sets for welding longitudinal bars for pile reinforcement, circular and bandsaws, etc.

The actual production in the yard presented no problems of importance.

2. Approach

Apart from the piling operations, no particular interest was attached to the construction of the approach.

A normal pile trestle contains three vertical and two piles raking in transverse direction. Every eleventh bent is an anchor bent for the pipelines, and contains three vertical piles and eighteen piles raking longitudinally. The pile-bents are spaced 20-ft. The piles are 14-in. x 16-in. by about 75-ft. long, each weighing about 4 tons. The inclination of the raking piles is 1 in 3.

With a view to the saving of timber for staging, it was decided to drive the vertical piles with a cantilever pileframe, and to drive the raking piles with a second frame travelling on the vertical piles.

The distance between the extreme piles in a pile-bent is 47-ft. An undercarriage with this span and having two girders 14-ft. apart was built. This undercarriage carried a turntable which could travel the full length of the undercarriage and carried two girders, on the end of which the pile-frame stood. The girders

New Oil Refinery at Fawley—continued

View of Pumphouse area on the left and of Main Jetty on the right.

were of such length that piles could be driven 20-ft. ahead of the previous trestle.

When the piles had been driven, they were cut at the proper level and capped with a steel cap. These caps carried a transverse steel girder, which in turn supported the girders on which the undercarriage was travelling. The pile-frame could turn round the clock and act as its own crane for picking up the transverse and travelling girders from behind, and transferring them to the row of piles last driven in front of its position.

The piles were brought up to the pile-frame by rail, and the transport bridge was located at such a distance from the approach that the frame could reach them and pick them up for driving. The piles were pitched by lifting at three points.

The second frame had an undercarriage carrying the frame mounted on a turntable and operated in the usual way. All motions except the travelling forward of the undercarriages were power-operated for both frames.

The hammers were 4-ton single-acting steam hammers, and the piles were driven to a set of 1 foot for one hundred and twenty 18-in. blows.

3. Pumphouse Area.

The construction of the reinforced concrete work at the pumphouse area presents nothing of unusual interest.

Under the pumphouse there is an intake chamber: 8-ft. x 66-ft., and a pump chamber: 27-ft. x 69-ft. These chambers are formed with Larssen No. 5 sheet piles driven by one of the floating piling plants described later. This driving has no features of particular interest, but proved a rather slow job, as movements of the piling plant made the pitching of the piles difficult and dangerous for the man who had to thread the clutches into each other.

The piles were 76-ft. long and driven about 35-ft. into the sea bed which had been dredged to -25-ft. The bottoms in the chambers are formed by a 2-ft. thick concrete slab concreted under water by the help of a tremie. An 8-in. diam. tremie pipe was used.

Prior to the piling operations for the pumphouse area, the pierhead trestle and the breasting islands, dredging to level -41.23 was carried out in front of the pierhead. This dredging was done by bucket dredgers under sub-contract by Messrs. James Contracting and Shipping Company Ltd., and involved the removal of some 400,000 cu. yds of spoil.

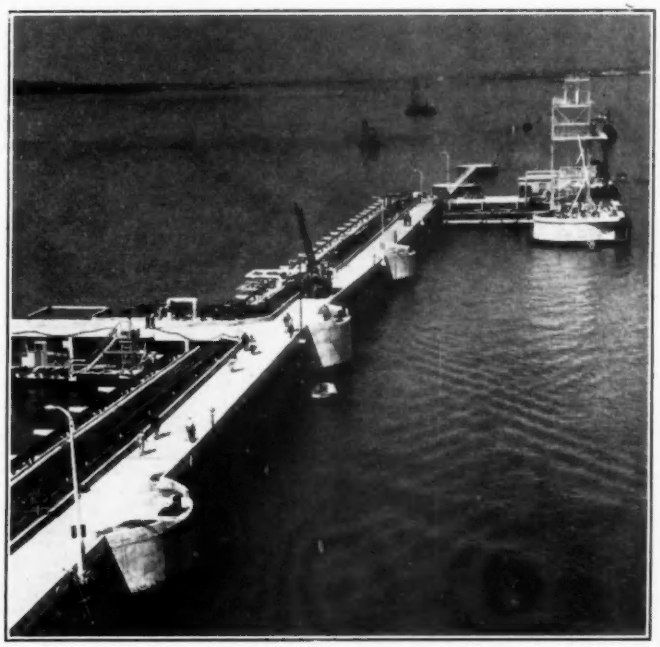
In addition to the general dredging, holes for the setting of the caissons for the dolphins were also dredged. This dredging had to be carried down to a firm bottom which was found in the form of gravel at about -57. The dredging was done mainly by bucket dredger, but also in some cases by grab. The great depth of the dredging meant that the bucket dredgers for the final cut could work at low tide only. This additional dredging involved some 90,000 cu. yds. of spoil.

4. Piling with Floating Piling Plant.

The cylinder piles were driven from two floating piling plants with 90-ft. high frames and provided with an $8\frac{1}{2}$ tons single acting steam hammer. Originally the piles were made open at the ends and driven as pipes but subsequently it was found advantageous to have a flat bottom with no shoe. The lower ends of the piles were therefore, prior to driving, filled for a distance of 2-ft. with concrete which also projected a similar distance beyond the ends of the piles. The pontoons carrying the piling plants were 60-ft. x 70-ft. x 9-ft. Each plant had two 20 N.H.P. coal-fired boilers, and one double drum and one single drum steam winch for the piling operations. In addition, the pontoons were provided with six steam winches as anchor winches. The anchors were 5-ton concrete blocks, and each anchor had 90-ft. of chain and 360-ft. of 3-in. cable.

The piling plants belonged to the contractor's affiliated company in Holland, and were towed over from Rotterdam, where they had been used in the reconstruction of that port.

Due to the great size of the pontoons carrying the piling plants, they are steady in most kinds of weather, and with this plant the driving of the 80-ft. long piles weighing 18 tons each, presented no particular difficulty. Once the anchors were laid, an average of fifteen piles per week could be driven, and an area 100-ft. long



View of north end of Marine Terminal.

New Oil Refinery at Fawley—continued

x 40-ft. wide could be commanded with the anchors in the same position.

It has been mentioned previously, that at the end of the temporary transport bridge, there was a berth for loading piles. This berth was 100-ft. long x 42-ft. wide and was spanned by a pair of gantries provided with 15 tons chain blocks.

The piles were loaded four at a time on to barges made by cutting the superstructure off L.C.T's., Mark V, and were transported to the floating pile-drivers on these barges.

5. Construction and Placing R.C. Caissons.

The construction of the caissons proceeded in five stages:

1st stage: construction of bottom and sides to a height of about 24-ft. This stage was carried out on a platform supported on steel joists suspended under four hydraulic jacks, each of 120 tons capacity for the 40-ft. diam. caissons, and of 70 tons capacity for the 36-ft. diam. caissons. When the sides were seven days old, the platforms were lowered by the help of the jacks, and were floated off at high water. The caissons then drew 9-ft.

2nd stage: Ballasting of caissons increasing the draught to 15-ft.

3rd stage: Increasing the height of the sides to about 45-ft. This increased the draught to 19-ft.

4th stage: Further ballasting increasing the draught to 29-ft.

5th stage: Increasing the height of the sides to about 66-ft. This increased the draught to 33-ft.

Stages 2 to 5 inclusive were carried out afloat alongside the construction yard for caissons. The sides were concreted in sliding forms in the usual manner for silos.

The 1st, 2nd and 3rd stages were commanded by a 10-ton derrick crane, and 4th and 5th stages by a 3-ton crane mounted on the top of a tower 30-ft. above deck level. This crane could slew round the clock. In addition to these cranes, mast hoists of 15-cwt. capacity were used for concreting the sides. The concrete for the sides was mixed at the yard for the construction of caissons and hoisted to the concreting platform in wheelbarrows. The siding proceeded at the rate of approximately 4 inches per hour, and the time occupied for completion of all five stages was about 5 weeks.

The caissons are placed on prepared beds. The amount of silt carried in Southampton Water is so great that the holes dredged for the caissons in the course of a few weeks filled with up to 7-ft. of slurry. This had first to be removed before the bed could be prepared.

The slurry was removed by a pump of the Mammoth principle. The air was supplied from a compressor with a capacity of 350 cu. ft. at 45 lb. per sq. in. per minute. This pump was driven by a 90 h.p. diesel motor. The delivery pipe was an 8-in. diam. pipe and the whole plant was mounted on a 70-ton barge.

When the slurry had been removed, the bed was levelled with gravel. Screeds were first placed by diver, and after that the gravel was deposited through an 8-in. diam. pipe with a large funnel at the top. The gravel was transported by a pontoon 40-ft. x 40-ft. x 6-ft. The pipe for filling was mounted in such a way that it could be moved along the whole length of the pontoon. The filling was controlled (screeded) by a diver.

Before the actual setting of the caissons, a craft 187-ft. x 38-ft. x 7-ft. (an old L.C.T. Mark IV) was moored as near the position for the caisson as the piles already driven permitted. This craft was moored wth six anchors, each having a 5-ton hand-winch at the end of the anchor cable. The craft could thus be brought into and held in any desired position.

The craft had a further four 5-ton hand-winches mounted along one side. From these winches, wire ropes led to the caisson in such a manner that two were at right angles to the direction in which the craft was moored, and two at an angle of about 45° to this direction. On the other side of the caisson, was another craft with a single anchor. This craft had one 5-ton hand-winch from which a wire rope led to the caisson.

The caisson was brought into position between the two craft mentioned in the preceding paragraph, just before high tide, and connected with them as described. By manipulating the wire ropes, by which the caisson was connected with the craft, it could be brought into the exact position in which it was to be set.

The actual lowering was accomplished by opening two 10-in. diam. gate valves and letting in water. The influx was such that the caisson went down at an average rate of one foot in one minute.

High tide was chosen for placing the caissons for two reasons: Firstly, they could be brought in over the holes in which they were to be placed with the greatest possible draught, and secondly, the tidal conditions in Southampton Water are almost unique in that the high water lasts for about three hours with a very slack current, whereas the low tide lasts for about one hour only. The reason for this is that the tide first comes in west of the Isle of Wight and thereafter east of it. There are actually two high waters with a slight difference between them.

When the caissons had been placed, they projected about 3-ft. above high water, and were then filled with sand before the superstructure was constructed.

6. Superstructure in Pierhead Trestle and Breasting Islands.

The precast frames and struts for the superstructures were loaded on to barges in the barge berth in the same manner as the cylinder piles, the frames and struts being placed by two floating cranes operating on each side of the two rows of piles supporting the frames.

Before placing the frames, the piles were cut down to their proper level just below high water with the reinforcement projecting 3-ft., and provided with steel caps. These caps served a threefold purpose. They supported a staging and working platform, they acted as shuttering for the concrete connecting the frames with the piles, and they supported the frames temporarily before the connection had attained sufficient strength.

One of the floating cranes had a lifting capacity of 30 tons, and placed the frames for the pierhead trestle and the breasting islands which weighed 18 tons and 10 tons respectively. The other floating crane was much smaller and had a lifting capacity of 3 tons only; it was used for placing the struts, working on the opposite side to the large crane.

The struts had each four bars projecting 2-ft. at one end and a few inches only in the other. The long projections were threaded through holes in the frames and welded to the short projections of the struts in the neighbouring bay. When this welding had taken place, the joints between the frames and the struts were concreted.

The steel fender piles weighing 7 tons were driven by one of the floating piling plants. The other of these was converted into a crane for erecting the frames supported by the fender piles. The fender frames were fabricated on one of the quays in Southampton Harbour, and the greenheart fender timbers were bolted on to the frames before they were erected. Each of the fender frames for the breasting islands with the greenheart timber bolted on weighs about 55 tons.

It will be understood from the above that a great deal of floating construction plant was required, and in addition to that already described, two floating concreting plants were in use, one large and one small.

The small one, which also carried a welding set, was used for concreting the joints between the precast members of the pierhead trestle and the breasting islands, and the large on was used for concreting such sections of the superstructure to which there was access by water only at the time of their construction.

Other craft were floating compressors for cutting down piles, two diver's craft with power-driven pumps for deep diving, and one diver's craft for shallow diving.

For the towing from one position to another of all this plant, for towing the caissons from the construction yard and for general transport of men and materials, several tugs, barges, and motor launches were continually employed. Also an anchor laying craft was in constant use for shifting the moorings, and a large gang of men was required for looking after all the floating plant.

At the peak period the contract was directed and supervised by a staff of 25 civil and mechanical engineers, 15 general foremen, and 30 trades foremen. For accounting, timekeeping, purchasing, storekeeping, and general office work, a staff of 25 were employed, and the number of tradesmen and labourers was 1,250.

Freight Handling

Review of the Report of a Specialist Team which visited the United States of America in 1950

FOREWORD

As stated in the Editorial columns in the September issue of this Journal, some attention and study has been given to the Report upon the tour of industrial installations in the United States by the British Specialist team on Freight Handling.

The team was one of those formed by the Anglo - American Council on Productivity, and the members were drawn from supervisory, technical and workshop levels, for the purpose of studying American production methods and reporting their observations and findings and making recommendations.

The Anglo-American Council on Productivity was formed in 1948 on the initiative of Sir Stafford Cripps, the British Chancellor of the Exchequer at that time, and Mr. Paul Hoffman, the Economic Co-operation Administrator in the U.S.A., the purpose of the Council being to promote economic well-being by a free exchange of knowledge in the realm of industrial organisation, method and technique and thereby to assist British industry to raise the level of its productivity.

The following is a review, with excerpts, of the Report of the Freight Handling team, in the preparation of which attention has been devoted more particularly to those aspects of it concerned with the Dock and Harbour industry. The reader will be able to judge for himself how much the British have to learn from American methods and to what extent adoption of any of them can be justified in United Kingdom Ports.

The British Freight Handling team consisted of members of the Railway, Road, and Docks and Inland Waterways Executives, the Dock and Harbour Authorities Association, the National Association of Port Employers, Transport and Trade Associations and Trade Unions, while the more numerous American collaborators represented the Association of American Railroads, Railroad Companies, Ocean Terminal Companies, Army Base Depots, certain Ports and Port Authorities, Employers and Employees' Associations and many Industrial Companies.

In the covering memorandum to the Council on Productivity, it is stated that the Report is addressed to all engaged or interested in terminal freight handling of rail, road or water-borne traffic. "It should not in any sense be treated as an attempt to survey the whole field of freight handling methods in America, so vast is the territory and so complex the problem in all its phases and refinements."

1. INTRODUCTION

The formation of the Team and the preparation of terms of reference had been discussed by the British side of the Anglo-American Council on Productivity and the following Terms of Reference were agreed :—

> "To examine and report on practices and methods in the use of mechanical appliances and terminal layout and design, for conveyance and storage in the U.S.A. of commodities by railway, road transport, docks and shipping organisations, including both domestic and inter-transfer movements, with particular regard to efficiency and economy."

Directly linked with the terms of reference were a number of particular phases on which it was desired that information on American experience and methods should be obtained at first hand. The general terms of reference, therefore, were elaborated and as far as the Port and Shipping Industries are concerned, the following aspects were covered:

Docks and Shipping.

(1) Examination of (a) various types of mechanical equipment used at docks to handle traffic between ships and quay and shed or warehouse and between warehouse and rail and road vehicle or waterway craft with reference to use of pallets, and (b) reception at the dock sidings of cargo for export.

(2) Examination of methods and equipment used for stacking and unstacking various classes of traffic in shed, warehouse, on storage grounds and stowage in ships.

(3) Inspection of types of mechanical appliances, other than cranes, used on ships in connection with loading and discharge of cargoes, e.g., appliances for clearing cargoes to the centre of the hatches for handling by crane, etc.

(4) Investigation of manning scales for operating various types of equipment and methods of assessing piece-work and bonus rates.

(5) To ascertain the reasons for the practice of the American Customs Authorities in refusing free temporary entry to foreign transit containers which results in traffic having to be trans-shipped into American containers.

"Although the Team's main attention was necessarily directed to subjects covered by the terms of reference—which in themselves were most comprehensive—there were many aspects of transport operation and practice of considerable interest which particular members of the Team would have liked to examine more extensively had time and opportunity permitted.

"The constitution of the Team—embracing rail, road and docks, managerial and trade union sides, with traders' representatives experienced in transport—provided a commendably well balanced cross-section of experience and outlook, and ensured that all branches associated with transport (management, labour and users) should have the opportunity of examining some American methods and technique."

2. BACKGROUND

In the Report, quite rightly, the very great differences are stressed between the American and British backgrounds and the bearing these must have upon any attempts to apply American handling methods to British conditions. On the other hand, it is noticeable, in regard to Rail and Road and Inland Water Transport, some such conditions exist at the present time in America as were in evidence in Britain prior to the passing of the Transport Act of 1947. It is, however, acknowledged, as in Great Britain, that the contribution to the nation's economy made by the Railroads has been, and still is, of the greatest importance.

"The vastness of the American territory, which supports a population between three and four times the size of that in Britain and is concentrated mainly in widely dispersed centres, the abundance of material resources and the general high level of commodity production create conditions for the large-scale unit movement of goods which, apart from justifying transport vehicles (road and rail) of larger capacity, considerably extend the scope for use of mechanical equipment.

Port Development and Operation.

"On the maritime side, the ample water space in which to develop port properties, coupled with relatively deep water at all states of tide, has resulted in most American ports being developed in the form of piers constructed in open water."

The Report might have added further that at most U.S. ports the range of tide is less than 5-ft., compared with ranges in this country four or five times as great which necessitates in Great Britain the building of enclosed docks entailing the heavy capital cost of construction, operation and maintenance of locks and gates, operating machinery and impounding plant. This fact has a great bearing upon the cargo handling methods employed and also entails a large increase in overhead charges and consequently in the cost of dock operations.

Freight Handling—continued

" A factor in port operation which has a direct influence upon mechanisation at ports is that at none of those visited did the port authority make itself responsible for the provision of any appreciable proportion of the machinery or equipment in use. Even in those cases where the authority was found to be the actual owner of piers, it generally leased them to shipowners or operators. Whereas in Britain a port authority generally owns all quays and sheds and sometimes operates them as well, providing quayside cranes for general use and, in some cases, engaging in most classes of labourage operation—so acquiring the major responsibility for the equipment of a port — American port authorities generally accept no such responsibilities. In America lessees of piers, etc., provide whatever equipment is deemed necessary for their particular classes of cargo and, as they are generally either branch organisations of the shipping companies directly concerned or agents for those shipping companies, mechanisation is introduced

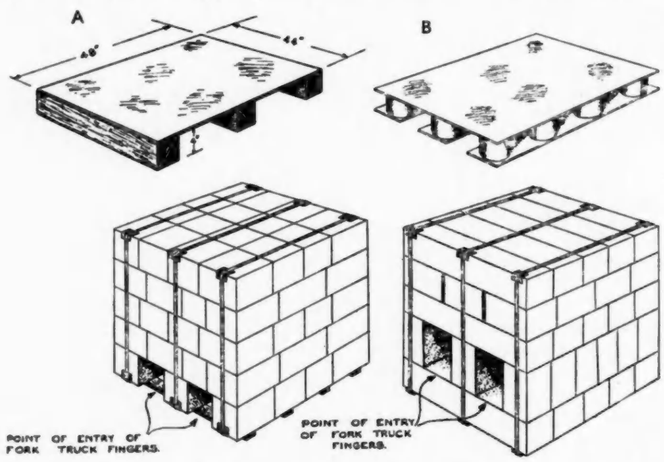


Fig. 1 (above). Expendable pallets. A, fabricated from double-walled cardboard (350 lb. test, A.B. flute); weight, 12 lb.; cost, 8s. each; maximum load, 15,800 lb. B, " cotton-reel-foot " type, constructed of fibre-board sheet with corrugated cardboard feet. Fig. 2 (below). Unit loads without pallets.

solely to meet their own particular needs without regard to multiplication or redundancy at piers or premises other than their own.

Time-Rates of Pay Preferred.

" A factor of interest in port working—and to a lesser degree in the other forms of transport referred to in more detail later in this Report—is the different method of payment for freight-handling operations in the two countries. It has become the common practice in Britain to pay dock workers at bonus or piece-work rates, e.g., so much per ton per man or per gang, the number of men to be employed in each gang being scheduled. The effect of this is that, if mechanisation results in accelerating the speed of handling and creates redundancy in gang strength, the employer, who has borne the capital cost of mechanisation, has to seek reimbursement by attempting to negotiate with labour a new agreement both in respect of manning and of bonus or piece-work rates per ton.

" In American dock operations neither labour nor employers regard piece-work with favour, and agreements for standard hourly rates of pay are common throughout the industry. Thus, although the existing agreements may in some cases prohibit reduction in the number of men employed per gang, if mechanisation increases the output per hour the employer still gains immediate benefit through the greater tonnage handled for the same hourly payment."

The above paragraphs of the Report are full of significance and indeed strike at the very roots of " mechanisation " problems.

3. PALLETISATION AND UNIT LOADS

" In view of the keen interest in all transport fields in pallet and unit loads, every opportunity was taken to examine American practice and to obtain up-to-date information about policy on the subject. . . .

" (a) **Extent of Use.**—Pallets are extensively used in domestic operations by private firms and transport interests in America to promote rapid handling, to reduce physical effort and costs, and to secure the best use of operational and storage space. Their use is growing.

" Generally, however, the use of permanent pallets is confined to such domestic operations, pallets being retained within the building or plant. In such cases traffic for despatch is taken off pallets at the sending point by the consignor for forwarding, and is sometimes re-palletised upon arrival at its destination.

" Enquiry was made as to why it was not practicable to extend the use of the pallet for the throughout journey and thus to avoid man-handling of separate packages in de-palletisation on despatch and re-palletisation on receipt. The following points were mentioned in reply :

(i) Firms use the size and type of pallet to suit their internal operational requirements and this is not necessarily suitable for throughout transit.

(ii) The necessity of providing additional stocks of pallets and of strapping or spot-gluing goods on to the pallet.

(iii) Difficulties of retrieving pallets and expense in maintaining records.

(iv) Freight rate on weight of pallet with load and on returned empty.

(v) Conditions of sale of merchandise, e.g., sale ex-works.

" In consequence, few examples of traffic passing on permanent pallets for throughout transit were seen, although the tour embraced some of the largest road and rail depots in America. . . .

" The general view in America is that, as the cost of permanent pallets is from $2.50 to $4.00 each, the solution lies in the development of an expendable pallet able to convey an economic load. This accounts for the increasing use of expendable pallets and for the intensive research and experiment now proceeding to develop this type. A number of firms have already demonstrated the advantages of the expendable pallet, particularly from the cost aspect. . . .

" In docks and shipping the palletisation of cargo in transit sheds is extensive, but in few instances is the through operation complete, as the cargo does not arrive at the shed on pallets.

" Export cargo on arrival at sheds is made up on pallets fitted with eyes or shackles, which serve as trays or scale boards, and stored two or three tiers high. When required for loading, the palletised cargo is taken to shipside and lifted into the ship's hold. Here the cargo is taken from the pallet and stowed in the usual way, the pallet being returned to the shore.

" Import cargo is made into drafts or sets on pallets in the ship's hold, lifted ashore, taken into the shed and stacked two or three pallets high, where it awaits delivery.

" There are, however, some notable examples of complete transport of palletised traffic from originating point to destination as, for example, by the American Army and Navy, and of partial palletisation covering the water journey from port to port (generally in the American continent), viz.: by shipping and distribution companies, where it is possible to exercise control over the movement and return of the pallets. The American Navy, in the course of their researches on the use of pallets and fork-lift trucks, give much consideration to and experiment with the re-design of existing transport media. i.e., they look beyond the mechanical equipment itself and consider how its use can be improved by the redesign of ships' holds and by the elimination of obstacles in the flooring of sheds, docks, etc. Similarly, it is also understood that ships operating between ports on the Great Lakes have been specially constructed with side ports, etc., to facilitate the handling of throughout palletised cargo.

" (b) **Type of Pallet and Unit Load in Use.**—Pallets are of permanent (returnable) or expendable type.

" (i) Permanent Pallets.—Permanent pallets in a wide range of materials, sizes and types of construction, were seen in America.

" American experience and research on both metal and hardwood pallets suggests unanimity in favour of hardwood construction of permanent pallets.

" (ii) Expendable Pallets and Unit Loads.—Very few expendable pallets, as such, were seen in use in America, but experiments are

Freight Handling—continued

Fig. 3 (left). Squeeze-grip fork truck attachment. As alternatives to the carton-handling arms shown the following arms can be fitted: (1) regular load grab, for general traffic, (2) rubber-faced, (3) spike-faced, (4) drum handling and (5) pallet load.

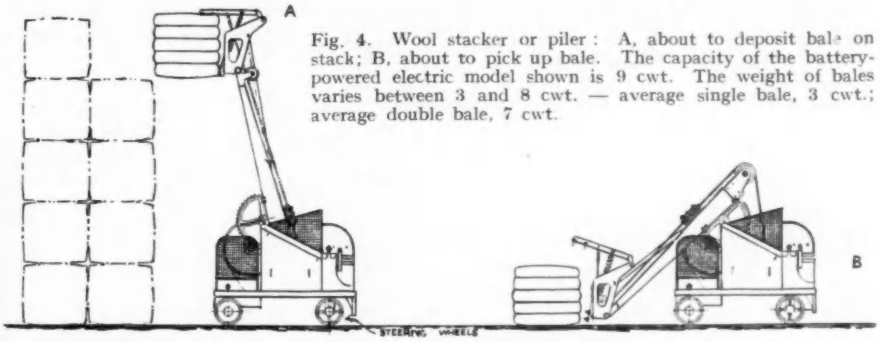


Fig. 4. Wool stacker or piler: A, about to deposit bale on stack; B, about to pick up bale. The capacity of the battery-powered electric model shown is 9 cwt. The weight of bales varies between 3 and 8 cwt. — average single bale, 3 cwt.; average double bale, 7 cwt.

being made with various materials and designs to develop an economic and efficient pallet of this kind.

" Fig. 1 shows two types of cardbord expendable pallets which are being tested in Britain and America. Such pallets are much cheaper to produce than their permanent hardwood or steel counterparts.

" Considerable progress is being made in America in the elimination of pallets by the development of unit loads and the strapping or glueing of the packages. A great variety of traffic lends itself to this method, particularly goods in packages of the box or carton type, uniform in size, which may be built into loads in the manner indicated in Fig. 2, leaving spaces within the load itself for the forks of the fork truck to enter. Wire-bound collapsed cardboard containers can be dealt with in this manner.

"(c) **Standardisation of Pallets.**—The desirability of standardising size of pallets has received a good deal of consideration in America, as well as in Britain. The American National Bureau of Standards, which has investigated the possibility of such standardisation, proposed two standard types—40-in. x 32-in. and 48-in. x 40-in. In this connection the dimensions of 96-in. inside car (rail wagon) width, and 80-in. inside truck (road vehicle) width, were the determining factors. Americans consider that possibly one additional standard size, 48-in. × 48-in., might be added. It is appreciated also that in any consideration of standards length of vehicle must be a factor.

" The American Navy favours 72-in. × 48-in. double-faced wing pallets of two-way entry and has adopted that type as standard. . . .

" In Britain, both the British Standards Institution and the Joint Non-Warlike Stores Standardisation Committee—with which transport interests and traders are actively identified—are dealing with the question of standardisation of pallet sizes. British Railways have indicated that, based on dimensions of their rolling stock, the most suitable standard sizes—although others can be accommodated—for rail conveyance of goods in Britain would be 40-in. × 40-in., or 40-in. × 32-in., enabled 10 or 12 pallets respectively to be loaded. Road vehicles in Britain have a maximum permitted legal width of 7-ft. 6-in., which will accommodate two pallets of either of these standard sizes within the width, side by side. The number of pallets which can be loaded on road vehicles naturally varies according to the length of the vehicle body.

" (d) **Rate-Charging Arrangements.**—An important and often decisive factor in determining the use of pallets for transport purposes, as distinct from domestic plant and warehouse operation, is the transport charge on loaded and empty pallets."

The Report goes on to compare British and American practice in regard to rail and road freight charges on loaded and returned pallets, the bases being broadly equivalent. Greater concessions are being sought in America.

" (e) **Operation of Pallet Pools.**—There is no doubt that, if it were practicable to establish pallet pools, either on a national or trade basis, advantages would accrue from the common user of pallets by the possibility of bulk purchasing, centralising repairs, minimising returned empty conveyance, etc. In Britain thought has already been given to such a scheme, but considerable difficulties arise by reason of—

(i) heavy cost involved in purchasing pallets to start the pool;
(ii) complication where pallets are retained on senders or consignees' premises;
(iii) extensive recording, accounting and documentation necessary.

" From time to time, statements have been made in Britain relative to the operation of pallet pools in America, but the most searching enquiry failed to reveal the existence of such a pool. For the reasons set out above, transport interests in America have not accepted responsibility for the establishment of a pool. . . .

" (f) **General Comment.**—Bearing in mind the greater experience of Americans with fork trucks and pallets, their general mechanisation-consciousness and the resources of timber available with which to make pallets, their larger rail and road vehicles which facilitate pallet operations, and the higher wages which offer increased potential for saving costs, greater progress might have been expected in extending the use of permanent pallets in transport in America—as distinct from local factory, depot, store and warehouse purposes. . . .

" The general attitude of transport providers in America is that the trader must take the initiative in the extension of palletisation to throughout transport, because any such consideration is inextricably interwoven with his present packaging and handling methods, and the important issue as to costs *versus* advantages is his particular problem; on this he must examine carefully the whole balance sheet. Nevertheless, it was noticeable that many transport operators, both road and rail, have adopted the use of pallets and fork trucks to assist the sorting and handling of miscellaneous traffic in their own depots. It seems reasonable to assume that, since this practice has proved most successful, these operators will in due course seek to persaude their customers to hand them traffic in a palletised form and, to this extent, will be taking the initiative in the development of palletisation.

" Transport interests in Britain have realised the potentialities of palletisation; in fact, there is already a varied use, where practicable, of fork and pallet trucks with and without pallets, in rail and road works and depots and in dock warehouses. Most of the principal ports in Britain have been experimenting with fork trucks and pallets, and some of the Team members were familiar with the complete palletisation of American equipment and supplies used in the D-Day build-up in World War II. It is recognised, however, that the peace-time commercial development of palletisation involves considerations different from those prevailing in time of war, in that in peace-time there is no unified control of pallet user, and greater regard to the cost aspect is necessary.

" The extent to which transport interests in Britain can secure advantages from palletisation depends on the prospects in two main directions: (a) whether traders are prepared by arrangement to increase the palletising of their commodities for transport, and (b) the domestic use by transport providers of pallets and equipment

Freight Handling—continued

to facilitate their own handling operations of all types of traffic in freight depots.

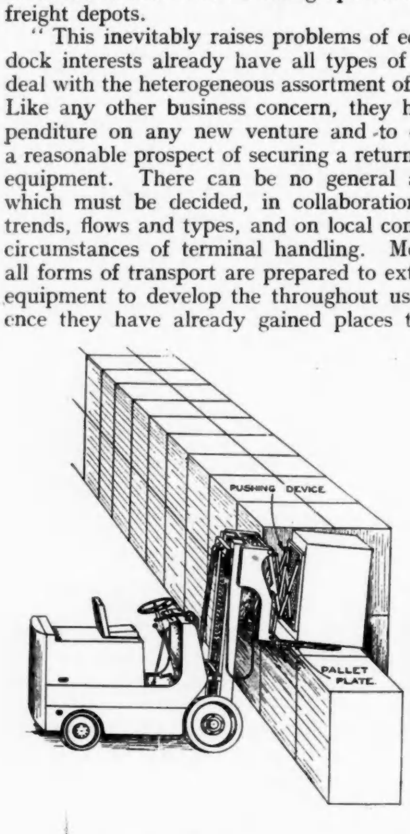
" This inevitably raises problems of economics. Road, rail and dock interests already have all types of mechanical equipment to deal with the heterogeneous assortment of traffic which they handle. Like any other business concern, they have to justify capital expenditure on any new venture and to consider whether there is a reasonable prospect of securing a return on the provision of pallet equipment. There can be no general answer to such an issue, which must be decided, in collaboration with traders, on traffic trends, flows and types, and on local conditions and the particular circumstances of terminal handling. Meantime, the providers of all forms of transport are prepared to extend the use of specialised equipment to develop the throughout use of pallets. The experience they have already gained places them in an advantageous

operation in confined spaces. Another of 4,000-lb. capacity has a 60-in. lift. A model of 4,000-lb. capacity with an 8-ft. lift is pedestrian-controlled and, in spite of an overall minimum height of only 6-ft. 9-in., has a free lift of 5-ft. 6-in., making it ideal for stacking and de-stacking inside covered vehicles. Machines of similar design are being built by British manufacturers.

" Although to a great extent fork trucks and pallets are complementary, they are not necessarily so, and the Team saw several examples of fork truck adaptations for use without pallets.

" A squeeze grip attachment to fork trucks (Fig. 3) is used to advantage for lifting and stowing many kinds of goods, e.g., bales of rubber, cotton and wool, drums, rolls of linoleum, etc., in warehouses and wagons, and is an alternative method of handling traffics for which piling machines are sometimes used in Britain (Fig. 4).

" A fork truck with pusher attachment (Fig. 5) is used success-



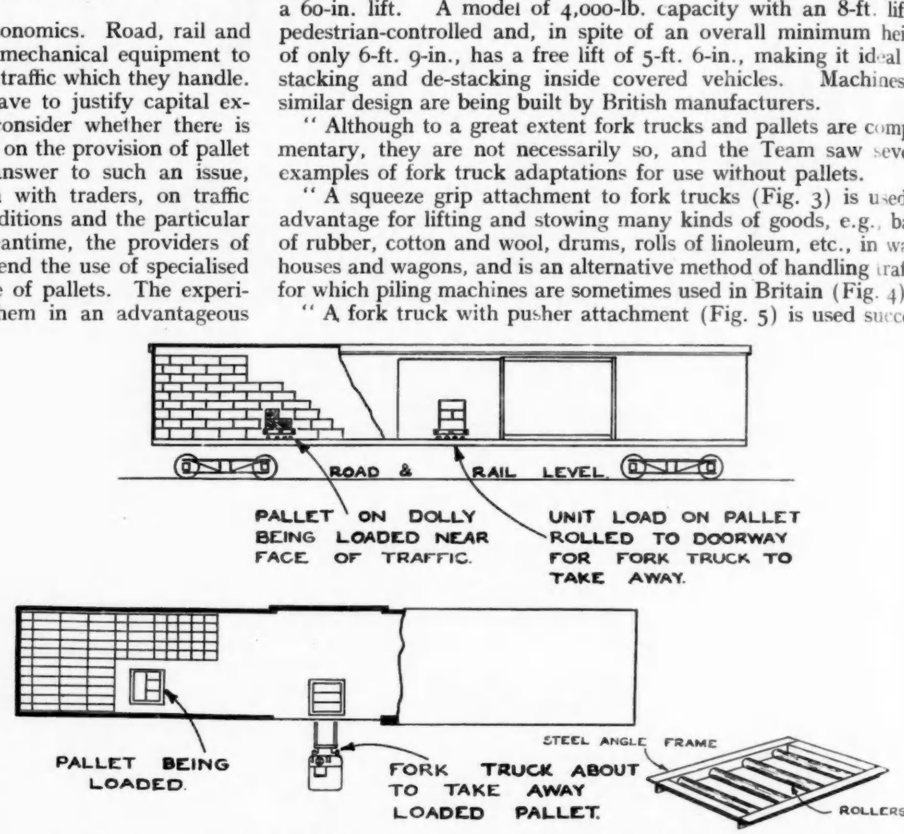


Fig. 5 (left). Pusher attachment to fork truck. Unit loads (single or multiple packages) may be deposited on the ground or on the floor of the vehicle or may be stacked as shown, thus avoiding pallets having to accompany the goods. If desired, the pallet plate may remain under the unit load to facilitate subsequent movement of the traffic. The pusher attachment may also be used in conjunction with " take-it-or-leave-it " pallets. Fig. 6 (right). Pallet dolly, showing method of use in car. Details of the dolly are indicated in the small drawing.

position, if and when increased palletised traffic is available for conveyance "

In connection with the use and Standardisation of pallets, it should be mentioned that a Sub-Committee of the British Standards Institution, representative of the Railway and Road Haulage Executives, industrial users of mechanical handling equipment, Government Departments, the three Services and makers of pallets and pallet-handling trucks, has for some time been engaged upon research and experiments, and in July, 1951, certain tests and experiments were carried out at Stockton-on-Tees. Nevertheless, and presumably with a view to co-ordination, the recommendations of the Report under review include a suggestion that a Central Committee be formed with the object of stimulating the development of palletisation.

4. MECHANICAL APPLIANCES USED IN TERMINAL HANDLING

The Freight Handling Team, during the course of the tour, saw a variety of types of mechanical equipment in railroad, road, dock, traders' and manufacturers' premises. Much of the equipment was not new to them, being already in use in Britain. Reference therefore is made in the Report to some of the more interesting uses of equipment in America and one or two new devices.

Fork Trucks.

" There is little difference between such equipment manufactured in either country to-day, as regards capacity, manœuvrability, height of lift, speed of operation, etc.

" Considerable thought has been given to the design of fork trucks suitable for working in conjunction with rail and road vehicles. One model seen in America, of 2,000-lb. capacity, has an overall width of only 28¼-in. and is admirably adapted for

fully in the loading of rail and road vehicles and on certain operations within warehouses. It enables unit loads to be handled either with or without pallets.

" Where there is no platform at the level of wagon or road vehicle floor and the fork truck cannot enter, a simple device for palletising the traffic during discharge prior to stacking in warehouse is in use. After the traffic near the wagon doorway has been palletised and taken away by fork truck, a pallet dolly (Fig. 6) on which a pallet is placed, is rolled to the remaining traffic. After the pallet has been loaded it is rolled into position at the doorway accessible to the fork truck. This avoids carrying individual packages from the ends of the wagon." . . .

Conveyors.

" For years manufacturers and transport interests in Britain have been developing the use of conveyors of various types for the economical and expeditious handling of merchandise traffic. At many transport terminals and docks, rubber belt conveyors, free rollers and slat conveyors are in use.

" Opinion in America in railroad, road and dock terminals, other than where the drag-line system is in operation, appears generally to favour power truck, fork truck, or tractor and trailer, in preference to such types of conveyors.

Use of Mobile Cranes with Pallets.

" Although pallets are normally handled by fork trucks, at a number of depots they are handled by mobile cranes with four-leg slings. This was said to be because of the higher travelling speed of the crane end, particularly where long trucking distances are involved, since the crane can deal with palletised traffic more expeditiously than a fork truck. H.F.C.

(to be continued)

Some Legal Aspects of Port Working

Various Liabilities and Rights of Dock Authorities

By S. H. KESSELS

In 1868 two obscure private gentlemen named Rylandes and Fletcher indulged in litigation which has made their names famous in legal circles ever since. (It is a wonder some enterprising journalist does not write the life stories of some of those litigants who unwittingly have built up our English case law). Their lawsuit established a principle, that if you keep dangerous things or animals upon your premises and the thing or creature should escape and cause hurt or mischief, it would be useless to plead that all reasonable steps were taken to avoid this mischief, for the " keeper " is liable for the consequences; but—and it is a big " but "—if the keeping of the thing that is potentially dangerous be done with statutory authority, then there is no liability for its escape if all reasonable steps were taken to prevent it.

This rule and its qualification much affect dock authorities, for water artificially impounded can be a dangerous thing if it should escape, say, by the collapse of a retaining wall or by seepage into neighbouring property. The statutory power by which most dock work is carried out is the salvation of the dock authority against claims which might otherwise, in some extreme circumstances, be enormous. The authority must take reasonable steps, it must not be negligent, and more than that is not demanded of it. In a High Court case in 1929, the owner of a riverside private dry dock alleged that the act of modernising and deepening a neighbouring wet dock, owned by a public authority, had allowed water to seep through and damage his dry dock. The authority, who did the work by statutory power, proved that in any case they had carefully used the best up-to-date methods to contain the dock water—that they had lined their new quays with sheet piling to a considerable depth. It was accepted that there was no negligence on their part, and so the claim failed.

This taking of all reasonable steps is the extent of the duty of a dock and harbour authority over the greater part of its operations. It must take these steps to keep the harbour approach (within its jurisdiction) and its docks and wharves as safe as possible for the users, the payers of dues and charges. It must clearly warn mariners of any wrecks of which it is aware or ought to be aware, it must mark them and if possible raise or dispose of the wreck (the harbour authority usually has powers or duties to that end and for the recovery of its expenses and charges from the owners of the wrecked vessel). It is not, however, expected to go to the extent of sweeping incessantly over its whole area in case there might be an obstruction somewhere. That sort of duty would depend on circumstances. Supposing a bridge or wharf had been demolished, then it is obvious that a good deal of debris might have fallen into the water in the course of the work, or that pile stumps might be exposed, and it is obviously a reasonable step to sweep or examine the site afterwards and make it safe. The impossible, the absolute guarantee of safety, is not expected.

There was a case in which a barge sank and must have become wedged in a trough in the river-bed, a trough of the sort that form and re-form continually where the bed of a river is " lively." It was no doubt rapidly covered with silt, and sweeping over a period of months failed to reveal it. Many years later the wreck turned up some distance away and was the cause of damage to another vessel before its presence was otherwise known. The harbour authority was not liable to the owners of the damaged vessel.

The legal position is much the same with regard to the handling of goods which come into a dock authority's custody. In this part of its work the dock owner is a warehouseman, that is, at law he is a " bailee for reward," and his duty goes no further than the taking of reasonable steps to safeguard goods in his care. It does not mean that goods must be actually in a warehouse to bring the dock owner within the category of warehouseman. They may remain on the quay only ten minutes or so after delivery from a ship and before loading to a truck or lorry —or vice versa. So long as they are in the custody of the " warehouseman," his duties are those of bailee for reward. There are, of course, various aspects of these duties, many of which were set out in an article which was published in the March, 1948, issue of this Journal.

By the same general law, a warehouseman is not automatically liable for the value of goods stolen from his custody. For such a claim to succeed, it must be shown that the warehouseman was negligent in his manner of custody, and what is regarded as negligence depends upon the circumstances. " Reasonable steps " to ensure against larceny may include the customary supervision by responsible officers, the locking of warehouses at night, the placing of especially valuable goods in a lock-up, the provision of police or watchers, who, among other duties, should check the passage of goods through the exits from premises which are otherwise enclosed by a proper fence or wall.

The law as to larceny puts a dock authority in a happier position than a railway company (which the present Railway Executive still is, in this legal respect). Subject to any special terms of contract which may have been made, the railway company is generally liable for goods lost by larceny or otherwise, or damaged. The owner of the goods does not have to prove negligence on the part of the railway company, which is in law a " common carrier."

The difficulty of a dock owner may be that, as his operations are so varied, at some places and times he is acting as a warehouseman, at others as a railway owner or " common carrier," or a lighterman. Lighterage in London is usually done under the terms of the London Lighterage Clause, which is to the effect that goods are carried at the owner's risk, except in the case of larceny—where liability is borne by the barge owners, but only up to £20 a package, and not over £50 a ton. The pilferage or theft must have occurred from the barge and in the course of transit to bring the owner of the goods within the benefit of the Clause.

Somewhat more positive than the duty to take reasonable steps is the duty of an employer towards his workpeople or those other workers who use his premises. He must provide safe premises and a safe system of working. What is " safe " depends, of course, upon the practice and the result, but in the case of docks the duties are laid down fairly definitely in parts of the Factory Acts and in the Docks Regulations of 1934 (Statutory Rules and Orders, 1934, No. 279). The latter concern not only dock owners or managers, but shipowners and masters and the workmen themselves. There are also the Shipbuilding Regulations, 1931, which may concern a dock owner if he also owns a dry dock, but many of the duties under these Regulations are put upon the shipbuilders or repairers and the shipowners.

The article on injuries at work (in the January and February, 1949, issues of this Journal) dealt at some length with the Docks Regulations of 1934 and the Factory Act of 1937, and it is not proposed to repeat the observations here, except to make a brief remark on Regulation 1 (Safety of access and of work-places). Certain parts of a dock must be fenced by safety chains of not less than 2½ feet high, especially at breaks, dangerous corners or edges of a dock, wharf or quay, as well as the sides of and approaches to footways over bridges, caissons and dock gates; but this does not mean that the whole of a quay edge must be fenced, nor does the Regulation require that safety chains be always in position. The practice is, and the Regulation allows, the taking down of chains from quays and gantries and the like when work is in progress. It would obviously be a hindrance —indeed, an added danger—if chains were left in place to impede the mooring of ships or the swinging of sets by crane, and the Courts recognise this fact.

The liability of a dock authority towards people who use its docks and premises depends also on the general law as to invitee, licensee and trespasser. The duty is highest to an invitee, that is, to one who is directly or by implication invited in (and this includes workmen, stevedores and sailors, who must cross a quay to get to a ship, and many people having definite business in the dock). Apart from definite duties under the above mentioned Regulations or Statute, all reasonable steps must be taken to make premises safe for an invitee.

Some Legal Aspects of Port Working—continued

The licensee is one who is merely allowed or suffered to be on the premises, and the duty towards him is only to warn him of traps (i.e. concealed dangers) of which the owner or occupier is aware. Otherwise the licensee must take the premises as he finds them.

A trespasser is one to whom the owner or occupier of premises owes no duty, except that he must not create concealed dangers with intent to injure the possible trespasser (and this a dock authority is hardly likely to do).

It is often not easy to decide if a person at any particular time and place is an invitee, a licensee or a trespasser, and sometimes a person who is an invitee at one part of a dock, or when doing a certain job, becomes a mere licensee or even a trespasser if he wanders off his proper route, or does something else which is not part of his normal duty.

When the question arises of invitee or licensee, one test applied is this: "Is there a purpose, a common purpose in which both occupier and the person who goes on the premises are interested?" In the case of workman and employer, or carman bringing goods to the warehouse and so on, the common purpose is clear. A father who went to a railway station to meet his daughter and help with her luggage was held to be an invitee, but those who may come as friends or relatives to meet passengers from a boat in an ordinary commercial dock would most likely be in the "lower" category of licensees. Such people, however laudable their action towards their friends, would not have a common purpose with the dock owner, but would rather be a hindrance to him, for when he allows them into the dock he may have to provide police or the like to direct and shepherd them; so that so long as there be no "traps" (like unlit, unfenced cavities), these persons would have to be vigilant to avoid the impedimenta that usually litter a dock.

New Type of Quayside Fender

For some months past, a new type of quayside fender has been successfully used in the berthing of Union-Castle ships at Southampton. It was invented by Captain A. J. Tweddell, one of the Company's assistant marine superintendents in the port.

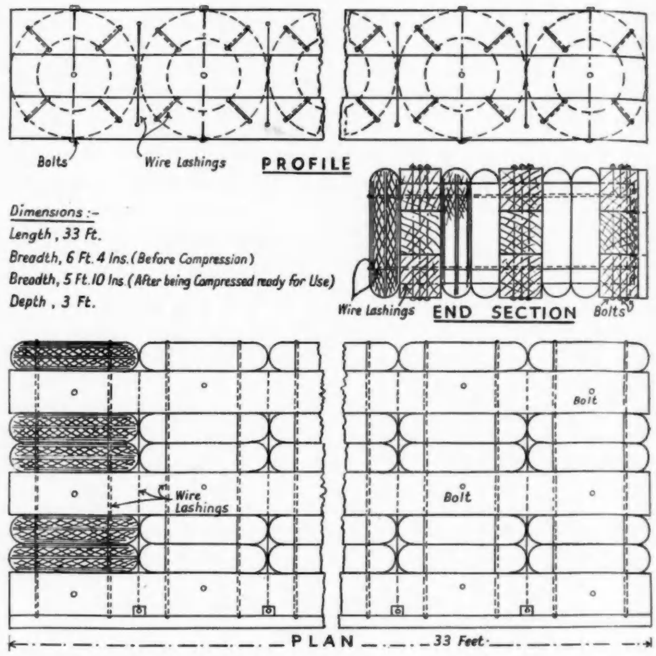
When the term "fender" is used in connection with shipping, it is generally assumed to refer to one of the many devices designed for the protection of vessels lying alongside other vessels, or alongside a quay or wharf.

It has, however, for some years now been the practice of dock authorities to place in the water alongside quays, solid blocks of timber which are frequently referred to as "fenders" or "dummies," and while these afford excellent protection for the quays, and are also useful in acting as "distance pieces" to maintain a vessel in a position at a fixed distance from a quay for possibly greater efficiency in loading or discharging cargo, etc., they most certainly do not afford any protection whatever to vessels. On the contrary, they constitute a very real and constant source of danger. Floating as they do, in the water, they are at all times in direct contact with a vessel at a very vulnerable part, namely at, and immediately below, the waterline.

It has been assumed in the past that vessels would be placed alongside these "dummies" gently. This is, of course, usually done, but there are many occasions when, owing to weather conditions, etc., it is not possible to do so, and on these occasions it is not unusual for a vessel to strike a "dummy" with considerable force, and thus suffer damage to her shell plating and possibly frames at, or below, the waterline.

Quite apart from any danger of sudden damage occurring owing to weather conditions during the operations of docking or undocking vessels as described above, there is always present the danger of damage to the shell plating and frames through undue pressure of the vessel against the "dummies." This may be brought about by a strong "on shore" wind and, in some instances, by the failure of those responsible to take the strain off moorings on a rising tide. In either case the entire pressure exerted is transferred to the area of the shell plating and frames in the immediate vicinity of the "dummies" making contact with the ship's side. This undue pressure may actually cause damage, and, in any event, must at least reduce the strength of the structure at the affected places.

In order to eliminate as much as possible the potential dangers of damage to shell plating and frames, and thus save considerable expense and time, at present lost in avoidable repair work, the new



type of fender referred to above has been designed and constructed at Southampton. It is a floating fender made of wood and rubber, is comparatively flexible and is of such a character that it will absorb very great shocks and pressure, and will moreover, conform to the shape of a vessel striking or pressing against it, and when the pressure is released, it will return to its original size and form.

Two of these fenders have now been used by vessels of up to 29,000 tons at Southampton Docks for some time, and have proved to be eminently satisfactory. They were made in the Union Castle Yard and a patent has been applied for. They are 33-ft. in length, 6-ft. wide and 3-ft. in depth, and weigh 10 tons each, but, as will be seen from the accompanying diagram, fenders of this type may be made to size, weight or shape to meet individual requirements.

By the experience gained from the original fenders, the inventor has been able to introduce a very much improved design. This is based on the same principle, but larger rubber rings are used together with a number of smaller rings, which are "staggered" and the securing lashings so arranged that each ring interlocks with each adjacent ring, thus assuring complete solidity without any loss of buoyancy or of the facility of compression.

Stability also is improved.

Arrangements for adjusting the lashings have been made more accessible and are on top of the fender, clear of the water, and all projections such as bolt heads, eye plates, etc., have been recessed so that a clear smooth surface is at all times presented to the ship's side.

New Ferry Terminal at Zeebrugge.

Work has commenced in the outer harbour at Zeebrugge on the construction of a new terminal for the British Railways' ferry service from Harwich. The terminal, which is expected to be ready next summer, will avoid the necessity of passing through the lock and will reduce the round voyage time by about two hours. Trade on the Harwich-Zeebrugge route has increased from 70,783 tons in 1938 to 102,242 tons in 1950; for the first seven months of 1951, the tonnage carried was nearly 73,000 tons.

Review of Trade Harbours

Docks Executive's Reports to British Transport Commission

The British Transport Commission is required, under Section 66 of the Transport Act 1947, to keep the trade harbours of the country under review, in order to determine whether schemes should be prepared to secure their efficient and economical development, maintenance or management. The Commission delegated this duty of review to the Docks and Inland Waterways Executive and requested the Executive to advise it whether in particular cases schemes should be prepared for submission to the Minister of Transport. The Commission has now published the reports made to it by the Docks and Inland Waterways Executive following the Executive's visits to the principal port areas of the country during the year 1948/50. Copies of the reports can be obtained from the Docks and Inland Waterways Executive, 22, Dorset Square, London, N.W.1, price 2s. (2s. 2d. post free).

In carrying out its review the Executive met the port authorities concerned and had discussions with representatives of the users of the ports and of workers employed in them. The discussions were directed in particular to consideration of the following matters:—

(a) Efficiency of operation, including adequacy of berthage and equipment, and performance of services to meet present and possible requirements.

(b) Financial circumstances.

(c) Constitution of the port authority.

(d) Whether advantages would be gained by grouping certain trade harbours with one another.

(e) Provision of services and labour conditions.

The Reports now published cover the port areas of the River and Firth of Forth; Dundee; the North-East Coast; London; Merseyside, Manchester and Preston; Bristol and Avonmouth; and Cumberland, and contain the impressions and recommendations of the Executive in respect of each of these areas.

The Commission has already submitted to the Minister of Transport a Scheme for the River Tees and the Hartlepools, and propose to exercise its scheme-making powers under Section 66 of the Act in the case of the Clyde and of Aberdeen.

The following are a few of the principal conclusions and recommendations in respect of certain of the more important ports and port areas:—

London.

In its Report on the Port of London the Executive emphasises that against the background provided by the great array of port installations administered by the Port Authority, there are features that stand out, at least in degree, which are peculiar to the port, for example :—

(a) The large amount of traffic handled at privately-owned riverside public wharves, over which the Port Authority has no direct control.

(b) The large amount of traffic handled overside to lighters and the consequent importance of the lighterage service, any interruption or inadequacy in which has an immediate effect upon the operation of the port, but over which the Port Authority has no effective control.

(c) The large number and variety of separate employers operating in the port and the diversity of conditions under which the registered dock worker may be called upon to work.

(e) The representation of the port workers by three different Trade Unions, viz.: The Transport and General Workers' Union, the Watermen, Lightermen, Tugmen and Bargemens' Union, and the Stevedores' and Dockers' Union.

This division of labour representation has been found to militate against a common policy being presented. Moreover, a variety of industrial agreements have been concluded between the Unions concerned and particular employers' associations, which arrangements have grown up over many years and were not a serious factor until the introduction of de-casualisation, but have resulted in men working under a variety of agreements which they do not always understand. It is pointed out also that in many cases work is carried out in physical surroundings and conditions which are below accepted modern standards and mention is made in particular of sanitary accommodation, canteens, supply of drinking water, washing facilities, drying of clothes and medical facilities. The latter it is stated are not up to the standard which the Executive has noted in some other ports of the country.

The Report mentions that in spite of recent technical developments in equipment, and although additional mobile cranes have been introduced and experiments have been made in regard to mechanical aids, such as fork-lift trucks and the pallet system, general cargo throughout the port is handled in the main by methods similar to those employed before the war. Also the suggestions made by the Working Party on Increased Mechanisation in United Kingdom Ports, have not been adopted, i.e., to the effect that shipping companies and stevedoring firms should collaborate with a view to the introduction of a system of interchange and that a pool of equipment of general utility type should be provided for hiring from the Port Authority.

On the other hand, the Executive referred to the extensive damage from enemy action which the Authority's premises had sustained, and acknowledged the achievements of the Port of London Authority both as to its progressive pre-war development policy, its prudently managed finances and more recently the reconstruction of war damaged facilities which had been pursued energetically with careful thought, hard work and loyal service of the staff.

Having regard to the future the Executive points to the state of labour relations as the most disturbing factor, and state that it has come to the conclusion that the efficient and economical operation of the port would be promoted by a scheme under Sect. 66 of the Transport Act, to provide for the reconstitution of the port authority. In the Executive's view, improvement can be achieved if (a) the Port Authority is reconstituted so as to provide greater and more direct representation of labour employed in the port; (b) greater responsibility is vested in the reconstituted authority; (c) closer cohesion is secured between the employers in the port, coupled with greater co-operation between the employers and the trade unions and the standardisation of labour agreements and conditions as a corollary to the Dock Labour Scheme; and (d) a spirit of co-operation is substituted for one of rivalry between the trade unions.

In all the circumstances, a scheme should provide inter alia, for the reconstitution of the Port Authority; control by the Port Authority over the provision of port facilities and services ; co-ordination through the B.T.C. of capital development; and the application of Part V of the Transport Act, which relates to the Transport Tribunal and charges schemes. The Executive is convinced that a thorough examination of the application of the Dock Labour Scheme in London is necessary in the interest of the efficient and harmonious operation of the port.

Liverpool.

Attention was drawn in the Report, to the constitution of the Mersey Docks and Harbour Board and that the Board and the Liverpool Chamber of Commerce expressed themselves as satisfied with the present constitution, and the Ship Owners' Association's view was that it provides representation of the various interests who pay the rates. On the other hand, the Birmingham Chamber of Commerce felt that shipping interests dominated the Board, and by reason of the residence proviso, the greater part of the Midlands, which has a considerable interest in the trade of the port, is excluded from representation on the Board. Moreover, the Transport and General Workers' Union considered that a smaller number of board members would make for more efficient administration and they looked for representation of organised labour on the Board.

Mention is made of the existence of the multiplicity of small concerns undertaking, under licence of the Board, shipping, stowing and vice versa of cargoes, with limited resources and equipment, to which was attributed the cases of indiscipline and ineffective supervision of which the Executive heard complaint.

The Executive gained the impression that, as in many other parts, the turn-round of shipping since the war has not been satis-

Review of Trade Harbours—continued

factory and to some extent it seems that difficulties of working have been accentuated by the increased use of road transport and to certain customary practices in regard to the unloading of road vehicles.

As in London, war damage was very intensive. Since the war, therefore, the port has been hard pressed to accommodate the traffic, which problem has been aggravated by the post-war increase in exports, the increase in size of vessels, etc. Pre-war tonnages of cargo handled per year have, however, been equalled, a result achieved by additional use of mechanical aids. Portal cranes on the other hand are not extensively used in the Board's docks, loading and discharging being carried out by ships' gear to a much greater extent than in any other comparable port of the country.

Like the Port of London Authority, the Board is treating rehabilitation and reconstruction as one major problem and mention is made of the reconstruction scheme for the Langton, Brocklebank and Canada Docks area, already sanctioned.

From the meetings with port employers and the Trade Unions it was clear that although relations were better than in the Port of London, there were nevertheless a number of outstanding and important problems unsolved. It seems that although substantial expenditure has been incurred in providing mechanical appliances for loading and discharging purposes, instead of financial and other benefits accruing, increased handling costs has been the result. Moreover manning scales for fork-lift trucks on inward cargo work has not yet been agreed, and employers were reluctant to press for arbitration, fearing that such action might bring about a general stoppage of work.

In general the amenities for dock workers in the port were reasonably good, medical services in particular are of a high standard and are much appreciated.

The Executive considers that in the interests of the conduct of the trade harbours of the Mersey now divided into several different ownerships, it is desirable that some effective measure of co-ordination between them should be ensured for the purposes of planning development, of capital expenditure and of operating policy; the question would also arise of co-ordinating charges by a charges scheme in accordance with Part V of the Transport Act.

It is considered that efficiency and economy would be advanced by a scheme or schemes which could deal with certain features that emerged. These include :—

(a) Liverpool and Birkenhead.—(1) The lack of effective control by the port authority over the provision of stevedoring and master porterage services; (2) the lack of balance in the composition of the port authority; (3) the inadequacy of the Mersey Docks and Harbour Board's sinking fund provision in relation to their present capital indebtedness and the magnitude of their reconstruction programme.

These matters need to be viewed in relation to the large amount of obsolescence in the port and the absence of any overall assessment of the future requirements of the area as a whole.

(b) Garston.—Consideration should be given in a scheme to the unification of these two ports with Liverpool and Birkenhead under the new body.

Manchester.

The Port of Manchester is owned and administered by a statutory body—the Manchester Ship Canal Company which, besides Port and Ship Canal, also owns the Bridgewater Canal, the Runcorn Docks and the oil docks at Stanlow and Eastham. Compared with the Port of Liverpool, the war damage suffered by the port installations was not extensive, and, in great part, that which did not amount to total destruction has already been repaired.

At the meetings convened by the Executive, it was stated that the Board of the Company had not so far been convinced as to the desirability of providing for the inclusion of persons drawn from the workers' side of the dock authority, the Corporation members of the Board already introducing a measure of labour representation.

Figures were supplied to the Executive illustrating the rate of turn-round of shipping as being more satisfactory in Manchester than in most other ports. The rate of discharging was generally in advance of pre-war figures, and was attributed to the introduction of piece rates during the war. Similar rates were under consideration for loading cargoes.

Timber discharging had been greatly facilitated by the use of mechanical aids for reception and removal of cargoes to the storage areas.

Little criticism was made as to available amenities generally but medical services and lavatory facilities needed augmenting and were in hand.

The conclusions, in brief, arrived at by the Executive are as follows : As at Liverpool it is desirable that there should be control through the B.T.C. of unduly competitive spending on the provision of new facilities and of the application at either port of uneconomic charges specially designed to attract traffic from the other. The existing requirements as to amortisation of debt also call for some tightening up.

The possibility of transferring the undertaking to a public trust was envisaged in the Ship Canal Company's Act of 1885, and while no desire that this step should be taken was voiced by any of the parties interviewed, it is considered that the present managing body is unduly large, and that there should be representation upon it of users and of organised labour.

Ellesmere Port.—In a scheme for Manchester, it would be necessary to deal with Ellesmere Port, which is owned by the B.T.C. but operated by the Ship Canal Company. The future of certain other minor docks and shipping places on the Upper Mersey would also call for consideration.

Conservancy.—A reasonable arrangement for the carrying on of the conservancy functions on the Upper and Lower Mersey might be the creation of a joint body. This would involve the winding up of the Upper Mersey Navigation Commission. Such a course would, however, require further examination in detail.

Bridgewater Canal.—The Executive considers that there is a strong case for its integration with the rest of the waterways. The canal was excluded from the transfer to the Commission of the country's inland waterways system.

Bristol.

With certain exceptions the ownership of "docks," as defined in the Transport Act, 1947, is mainly in the hands of the Bristol Corporation. The Executive noted that the statistics of the turn-round of shipping showed that the results achieved compared favourably with those obtained for similar cargoes at other British ports, and according to the Ministry of Food, Avonmouth had produced the best results in the country in respect to refrigerated cargoes. It seemed that as a general rule the individual output by the workers had improved by about 30 per cent. over pre-war level, which was ascribed mainly to the extension of piece rate schemes.

The loss of facilities in the port due to enemy action was comparatively small and new two-storey transit and storage accommodation was planned, together with improved facilities for the discharge of concentrates and other bulk cargoes.

In general the Executive found that represented interests were satisfied with the standard of facilities provided and the plans for making good present deficiencies.

On the whole, the port has had a good record of labour relations and the Executive did not hear of any serious outstanding differences in this respect, while the amenities in the form of canteen, medical and welfare facilities were generally regarded as adequate and would reach a satisfactory standard when the National Dock Labour Board's recent recommendations had been carried out.

In their conclusions the Executive recorded the local pride and the interest which was displayed by all parties in the well-being and efficiency of the port and considered that it derived from the city's long standing and traditional association with the maritime trade and commercial enterprise of the country.

The Executive considered whether advantages would be served by grouping Bristol with the other trade harbours of the Bristol Channel, viz. the South Wales ports already unified under the Executive, the docks at Lydney and Sharpness and various small ports along the Somerset and North Devon coasts of which Bridgwater and Watchet are the closest to the Avon Estuary. These harbours extend for a considerable distance on either side of a rapidly

Review of Trade Harbours—continued

widening estuary: they are not, in general, linked by good direct communications. At the present time, the Executive does not recommend a general unification; it considers that a stronger case might be presented for unification of the trade harbours on the English side of the Channel. Sharpness and Gloucester are becoming in a sense satellites of ports lower down the Channel and their future depends to some extent upon the growth of traffic up the Severn. To include, however, the whole administrative unit of the Severn Navigation would mean projecting the port of Bristol up to Stourport almost to the heart of the Midlands and such an extension would not be practicable while the port of Bristol itself remains under municipal ownership. The Executive is not aware of any circumstances which justify the inclusion of the smaller ports south of the Avon in a unification scheme. The Executive, in regard to Bristol itself, state that it is worthy of note that this port authority does not conform to the type of organisation which has been said to commend itself to port users. No criticism was, however, heard of the efficiency with which the undertaking is conducted by the Docks Committee nor of the present composition of the Committee, but the trade union representatives would prefer a constitution under which they had the statutory right of direct representation on the governing body. There are certain relatively minor matters which might be dealt with in a scheme but it is not now proposed to take any action by promoting a scheme.

Firth of Forth.

With regard to other ports dealt with in the Review, the following are a few brief excerpts :—

In the case of the Firth of Forth the Executive considers that unification of ownership and management to include the functions of the Forth Conservancy Board would conduce to development of the port services of the area; in particular it is considered that there is a good case for amalgamation of Leith and Granton.

The extent of unification and the form it should take need, however, further study in the light of industrial changes, and the Executive feels it best to defer, for the present, a recommendation of a general scheme for this purpose. If such a scheme were made it should empower the Port Authority to provide the services of towage, stevedoring and handling and warehousing of goods, and to license persons to perform such services in the port.

Dundee.

On Dundee the Executive made two reports, one dated May, 1950, and the other January, 1951. In the first it is stated that the future of the port is difficult to forecast, but such indications as there are seem to point to the conclusion that while the coastwise and short sea trades may continue to make substantial use of the port, a revival of deepsea trade to pre-war proportions is not likely. It might, therefore, be prudent to base plans for the future on the assumption that cargoes of a nature for which the riverside facilities are convenient and suitable will predominate. In that case, the re-equipment of the existing docks to bring them to a state of efficiency would not justify the heavy expenditure which would be involved.

The Executive does not consider that the time is yet ripe for the inclusion of the port of Dundee in a major scheme of grouping with other ports, either to the south or to the north, but they think that the necessary process of adjustment would be assisted if there were a single authority responsible for the conservancy of the River Tay and all the public ports on the river.

Following further consultation with local bodies, the Executive was unconvinced that any additional berthing accommodation could not be secured by better equipment and more intensive use of existing wharves and abandonment of obsolete docks. The Report emphasised the need for a more realistic approach to the problems of the port. The various parties concerned should get together to examine their problems and concert action locally to ensure that the best and fullest use of the existing facilities is obtained, and that any additional facilities needed may be provided most economically, rather than look for the provision of additional berths at high cost.

The Executive considers that greater efficiency and economy in administration would most readily be promoted by means of a scheme under the Act and recommend that they should enter into consultation on the type of scheme best suited to the needs of the area.

North-East Coast Ports.

In its review of these ports the Executive reported that, on the estuaries of the rivers Blyth, Tyne and Wear and adjacent coasts are a number of trade harbours, at which the shipment of coal and shipbuilding and ship repairing overshadow all other activities, and indeed the small ports of Blyth, Warkworth and Seaham may be said to exist solely for the shipment of coal produced at National Coal Board mines in the immediate vicinity.

The report proceeds to review the work and administration of the Tyne Improvement Commissioners, and concludes: Having heard all the evidence given and the views expressed by the parties, the Executive considers that there should be unification of the harbour undertakings on the river, and it is not fully satisfied that Tynemouth Corporation Quay should be excluded from such unification. It is intended to submit detailed proposals setting out the principal features which are considered should be incorporated in a scheme for the area. In addition to ensuring that the planning of new port facilities would be undertaken by a single body, these proposals will include provisions for a more balanced composition of the governing body and a reduction in its size.

River Wear.—The constitution, powers and development plans of the River Wear Commission were examined, including a development scheme estimated to involve an expenditure of well over £1 million. The Executive considers that the scheme cannot be justified as an aid to the shipbuilding industry, for it is a matter of common experience for shipbuilders to be restricted by the physical limitations surrounding their yards and in any case an individual shipbuilding firm would be unlikely to provide additional revenue commensurate with the cost of the scheme, without being placed at a disadvantage compared with competition not subject to such charge. In other respects also parts of the scheme appeared to be unjustified.

The financial background, it is stated, viewed in conjunction with the trading prospects and the other factors, suggests that this is an inopportune time for the Commissioners to embark upon fresh borrowing, and for the reasons given it is not considered that their further programme is at present justified.

The proposed extension of the Sunderland Corporation Quay for a distance of 510-ft. to provide an additional deep-water berth for the discharge of general cargo at a cost of about £½ million is regarded as "an extremely speculative venture" and as not likely to attract a sufficient volume of trade to justify the capital expenditure involved.

Conclusions on North-East Coast Ports.—The Executive, in its conclusions, was influenced by the fact that the area of the North-East Coast is in many respects industrially homogeneous, combined with the comparative proximity of each of the other ports and the similarity of their major activities, suggests to the Executive that they should, in the interests of economy, be administered and developed under a single control. This general conclusion is reinforced by the risk that under separate and independent management the ports may develop a large surplus capacity which will become an incubus upon the shipping and trade which use them, or upon the localities in which they are situated.

The Executive considered whether it should recommend the making of a scheme which would unify the trade harbours of the Tyne and the Wear under one authority. There appears, however, to be little disposition locally, either for the financially stronger authorities to accept responsibility for their weaker neighbours, or for the financially weaker to merge their individuality in a larger concern. To attempt complete unification immediately would probably be premature.

The Executive expressed the view that as a first stage a scheme should be promoted with the object of bringing the trade harbours of the Wear effectively under one management, and of establishing a smaller and more satisfactorily constituted body to that purpose. This body should be subjected to the control of the British Transport Commission, at least in respect of capital expenditure, and it is intended to submit proposals on these lines, in due course.

The Study of Wave Motion

Apparatus for Investigating Magnitude*

Whenever an important work is to be constructed in the sea, one of the first essentials is to know the nature and the magnitude of the wave motion to which the new structure will be subjected.

Formerly, the wave motion was observed visually by counting the alternative levels immersed and emerging upon a fixed ladder against the wall (dyke or breakwater), or even by a beacon painted with black and white rings, secured to the rocks or fitted into an artificial base placed on the bottom; alternatively, the movements of the water were observed in relation to a floating beacon stabilized by a large horizontal panel (perche de Froude).

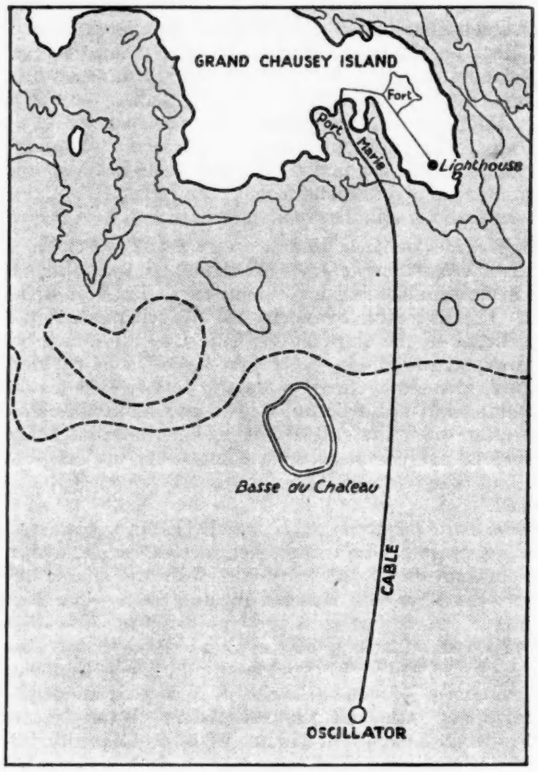


Fig. 1. Diagram showing arrangement of the wave studying layout at Chausey.

In recent years, however, it has been possible to make a detailed examination of the characteristics of the free surface of a surging sea with the aid of photographs taken in synchronism, although it is impossible to use any of these methods during a heavy storm —which is the time when observations would give the most valuable information. Consequently, an apparatus, placed on the sea bed has been designed to send impulses commensurate with the magnitude of the wave motion to a recording instrument situated on the shore.

Meteorologists observe wave motions along the coast as this assists them to forecast bad weather, and they use manometric recording of pressure variation on the bottom of the sea, and subsequently carry out examinations with frequency analysers. Thus a complex wave form can be analysed with sufficient accuracy to identify the part of the sea bed from which a storm has originated.

Engineers who are investigating the construction of works in the sea will not be satisfied with mere records of variations of pressure at various points on the sea bed, as such variations diminish in direct proportion to the depth, and because the conversion of the readings thus obtained into the actual heights of waves at the surface can only be effected by a complicated analytical examination involving coefficients which have not been accurately determined.

An apparatus recording directly wave amplitude and variations is to be preferred, and this has now been constructed. It is the "vertical sound emitter" which, when placed on the sea bed, emits the ultra-audible sounds which are reflected on the surface of the water and return as an echo, to act on the apparatus, which then functions as a receiver. It is thus possible to obtain a recording directly proportional to the depth of the water. An appliance of this kind has been used by the British Admiralty in Cornwall, and also by the French Navy, who used it to make recordings of wave motion off the coast of Casablanca. In this instance it was not fixed on the sea bed but on the hull of a submarine. The application described in this article, however, has been used by Electricité de France to make a trial study for an installation of a tidal power plant to the south of the Chausey Isles. The apparatus was supplied by Kelvin & Hughes (Marine) Ltd. and

Fig. 2. Transducer mounted in reflector with diaphragm removed.

was immersed in May 1949, about one nautical mile south of Grand île de Chausey (Fig. 1).

It is primarily composed of an oscillation unit, a submarine cable, a transmitter power unit and recording instrument. The oscillator unit which is shown in Fig. 2, is located on the sea bed, and consists of a magneto-striction transducer with a large reflector which has a stainless-steel diaphragm as a cover. At the sea end of the submarine cable there is a junction box, which forms a connection with the transducer element winding, and is filled with compound to prevent breakdown of the insulation. The oscillator unit must be sited on a substantial base already positioned so that it can be secured in such a way that the axis through the apex of the diaphragm is vertical.

The submarine cable has twin core 7/.029 copper conductors insulated with telecothene, and is armoured with 12 x .192-in. tarred galvanised steel wires. An outer wrapping of compounded jute yarn is provided, making the overall diameter 1.3-ins.

There is a second junction box whch can be mounted at any convenient position above high-water level at the shore end. This junction box connects the submarine cable to a landline which is carried on posts, to the recording station, where a third junction box connects the landline to the transmitter power unit. which supplies the supersonic pulses to the transducer through the sub-

*This article is based on a Report made by M. L. Vantroys, Chief of the Study Services for the Utilisation of Tides for Electricité de France.

Study of Wave Motion—continued

marine cable. The energy stored in a 4-microfad condenser is discharged through a gas discharge tube into cable and transducer, the discharge tube being triggered by a pair of contacts in the recorder. The "echoed" pulse from the transducer is received by the amplifier and the output is then rectified.

The recorder (Fig. 3) initiates the triggering of the transmitter power unit and records the interval between the transmission and the receiving of the rectified signal from the amplifier, i.e. the echo. The distance that the supersonic sound pulse has travelled through the water is measured by the time interval and can thus be recorded on a scale which is graduated in metres. The width of this chart is 12.5 cm. and represents 20 metres of water. The ratio of height of water to chart width is maintained by a mechanical arrangement, and the range can be adjusted to anything up to 80 metres depth of water in stages of 5 metres.

The D.C. supply in converted to A.C. single-phase 400 c.p.s. at 110-v., 22-w. by a small converter unit, and a typical arrangement of components and necessary cabling is shown in Fig. 4. A specimen of the wave-motion chart obtained is shown in Fig. 5.

Certain limitations on the instrument are enforced by design problems, and it cannot be used at depths of less than 3 metres or of more than 80 metres.

Watertightness of the immersed portions is an essential feature of an installation of this kind, and at Chausey the insulation did not remain in perfect condition, as leakage resistance which varied slowly, remained from May to December 1949, within limits that, did not however, compromise the results obtained with the apparatus. After that date the oscillation circuit became unbalanced, as the frequency of the wave train emitted did not preserve the value of 30 kc per sec. The regulation of the receiver amplifier was, therefore, modified and since then it has been possible to obtain perfectly legible and accurate results.

The installation at Chausey has been very satisfactory and it appears that an installation of this type could function with complete success for many years. The principle disadvantage is, of course, the expense of the armoured submarine cable, which in the case of Chausey cost as much as the rest of the installation put together, for a length of only 2 km.

On a coast with a very gentle slope greater lengths of cable would be necessary and for temporary installations the cost would be prohibitive. It might be possible in a region where it was desired to take multiple observations, to use one verticle sound recorder to synchronize a number of independent under water units that could be anchored in various points of the region to be explored.

In order to learn certain characteristics of a wave, such as the direction of propagation, the form of the free surface, and the division of pressures in depth, some apparatus other than the vertical sound emitter may be necessary, for example, visual, photogrammetric, manometrical recorders, but at present the vertical sound emitter seems to offer the surest means of obtaining precise recording, over an extended period of time, of the depth and the periodicity of wave motion, and from this information the effects exerted on any structures can be calculated with a satisfactory degree of accuracy.

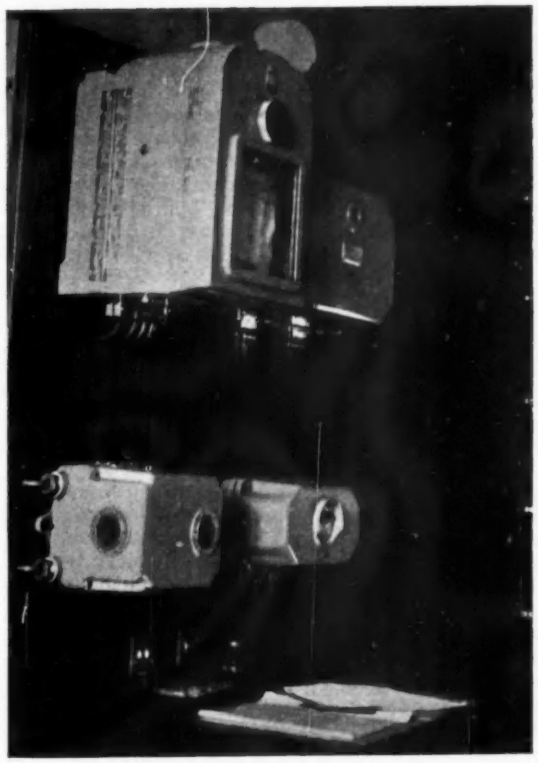


Fig. 3. Recorder and amplifier unit at Chausey.

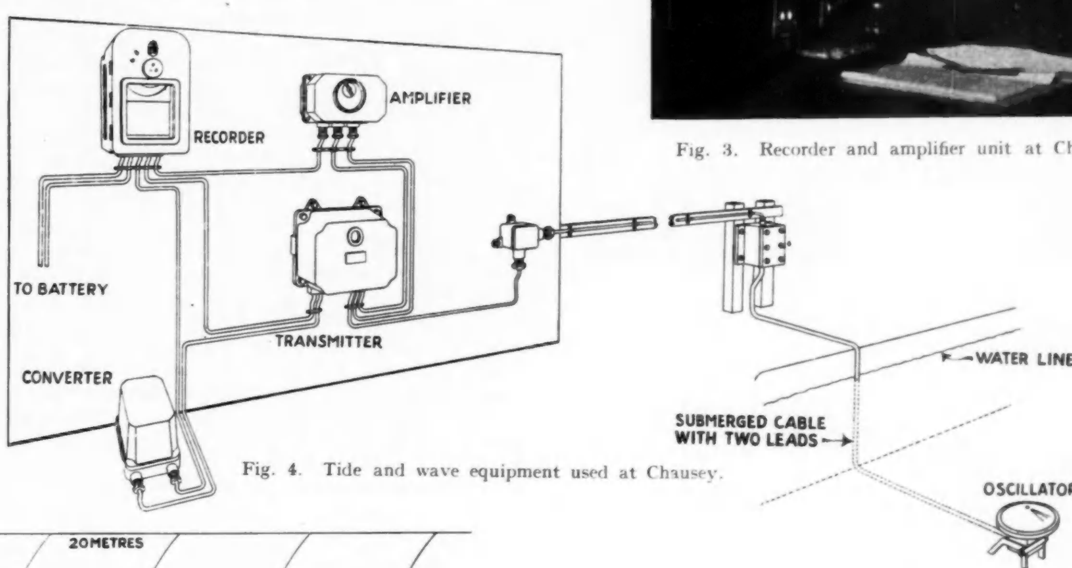


Fig. 4. Tide and wave equipment used at Chausey.

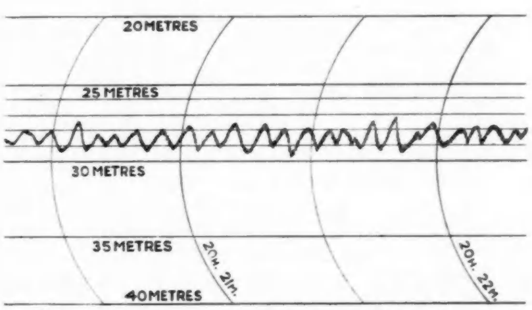


Fig. 5. Specimen of wave-motion chart obtained.

Book Reviews

Maritime Works, Volume III, Construction and Equipment of Ports, by G. de Joly, Ch. Laroche, P.H.Watier, and A. de Rouville. Published by Dunod, 92, Rue Bonaparte, Paris (VI^e^). 2nd Edition, pp. 810, figures 363, price. 3.500 frs.

A few years ago Mr. Robert Schuman, the famous French Minister, addressing a gathering of French Scientists and Maritime Engineers, said " . . . that which makes nations strong, above all a nation like the French, is the factor of complete development of initiative "; and, " French economy both here and in our overseas territories depends upon the manner in which our ports are equipped and upon our means of transport." These forthright words were uttered at a period when the port reconstruction of France was at its peak, under the vigorous direction of Messrs. P. Peltier and L. Coursin, the directors of Maritime and Public Works of France, and France overseas respectively. Their direction was marked by boldness and the port engineers were everywhere encouraged in initiative, to apply that which they knew to be effective in their locality to the solution of the particular maritime problems they had to face.

The outcome of this policy developed into a spate of constructional energy and ingenious methods to achieve substantial and effective ends. Ports almost completely destroyed, rivers cluttered up with wrecks, silt, and debris, docks razed to the seabed, cranes, warehouses, transporters, railways and all heavy equipment demolished, was indeed a depressing situation; and, as though that were not a sorry enough plight, there were little funds and a disheartened labour force to deal with it. Nevertheless the condition provided the opportunity for ingenuity and initiative of able minds and craftsmanship. The result we now see has given to France the most modernised ports in the world, and to the world of maritime engineering many brilliant examples of constructional method and equipment disposition

The present new edition is the accumulated work of four professors of the Ecole Nationale des Ponts et Chaussées, which freely translated would read the French College of Civil Engineering. Unfortunately the decease of the first three author professors interrupted the continuity of the original text and it became the responsibility of Professor A. de Rouville to complete the 1939 edition. The original volume of about 700 pages divided into seven chapters dealing with :

1. General arrangement of port facilities.
2. Wharves, quay walls and dolphins.
3. Dry docks, floating docks, launching ways, etc.
4. Navigational channel bridges and ferries.
5. Maintenance of depth of water.
6. Port equipment, cranes, warehouses and passenger stations.
7. Port administration

is now supplemented with an addendum of 100 pages written by Professor de Rouville. The outstanding features of this volume are the clear easy style, the fund of useful information imparted without complexity and the absence of mathematical elaboration. The seven original chapters cover the essential considerations of construction and maintenance of inner harbours, functional and politic, even though many of the examples given are outdated. Apparently there are reasons, mentioned but not explained by the author, why the original text must stand. This is unfortunate because much of the detail of the recognised practice of fifty years ago, however adequate at that time, such as sluicing basins, dredging methods, heavy coursed stone quay walls, ferries, slipways, etc., could have been omitted or reduced, to give place to the more adaptable and the more ingenious constructions and appliances of the present day. It should be more widely known that the extensive programme carried out by the French engineers in the last six years surpasses all that has ever gone before and is without question more highly efficient in conception and performance than any conceived in pre-war France: it challenges the best of the New World.

The addendum so ably written by Professor de Rouville is not adequate. It fails to give a true cross-section of the present-day practice of French Maritime Engineering; for example, only brief mention is made of the several types of quay walls at Havre, each one designed to fulfil site conditions, present-day uses, and adapted for economical modification for future functional changes. The composite Chanzy Quay at Boulogne, so well conceived and ably constructed, was worthy of detailed description, it was an excellent solution to a difficult problem. In an important work like the present volume I expected to find some mention, if only brief, of that outstanding cofferdam construction at Lanninon, Brest, which combined the unique feature of a caisson entrance to allow the passage into No. 8 dry dock of the battleship " Jean Bart." This was undertaken so that the work of repair of the demolished Nos. 8 and 9 dry docks entrance heads, and the battleship, could proceed concurrently in the dry. The wealth of material of modern maritime engineering practice available in France is tremendous, the rehabilitation of Rouen, Marseilles and Havre merits a volume in itself. The new type sector dock gates at St. Malo and the ingenious and economical cofferdam construction at the same port have novelty and boldness of professional skill. These are but few of the many items that Professor A de Rouville with his consummate ability could have detailed for the benefit of the profession and the credit of the constructors.

As it is, the addendum is concerned with adding newsy notes to the original text and is somewhat awkwardly confined to the last 100 pages of the volume, entailing frequent back reference. The publisher's blurb points out that the additional matter deals with new types of construction of wharves, docks, quayside equipment, etc., pointing out that because of the war the constructions are now more slender than of old, for two reasons: (a) the state of the National Finances, (b) the distrust or apprehension of future dislocation rendering permanency impossible. I feel that such sentiments are not applicable and do not do justice to the French Engineering Profession, whose ability has been so amply demonstrated.

Most of the addendum is concerned with dredging, and the salvage and disposal of wrecks, from the legal and administrative point of view, and further deals with port administration, police, security of merchandise and the handling of dangerous material, etc.

Sometimes it is difficult to show the regard that one nation has for another and the interest that arouses it; nevertheless, to be bold, as I would have wished the publishers to have been, I would suggest that the volume is not international, as they claim, it is French, but not sufficiently so, as we had hoped. For those who know the language the fluent phraseology throughout makes the book interesting reading and, subject to what I have remarked above, very informative on most matters concerned with port facilities and should be of great value to junior engineers and students. In conclusion, I would like to again refer to Mr. Robert Schuman's concluding remarks in the address already noted : " Let France know what right she has in taking confidence once more in herself and through that in her destiny. Let us look at the results here and be proud of our great national tradition."

" The Design of Prismatic Structures." By A. J. Ashdown. (London: Concrete Publications, Ltd. Price 8s.).

A new and economical method of designing sloping reinforced concrete slabs for pitched roofs, the bottoms of bunkers, and other purposes (known in the U.S.A. as " hipped-plate " construction) is fully described with worked examples. It is claimed that this type of construction has several advantages compared with the thin curved " shell " roofs which are now becoming popular. These advantages include cheaper shuttering, the fact that some parts can be precast, and that the formulæ and calculations are much simpler. The relaxation method of solving equations is clearly described.

Electronic Apparatus for registering the levels of water in a reduced model.—Professor J. Lamoen, the Director of the Belgian Hydraulic Research Laboratories at Antwerp, has produced in collaboration with Mr. O. Robberecht an electronic devise to register the changing levels of water in reduced models, in function of time. It has been tried out successfully not only in his own laboratory but also in the famous French Service de Mesures du Laboratoire Dauphinois d'Hydraulique.

Colonial Harbours and Wharfs

Some Notes on Recent Developments*

By R. D. GWYTHER, M.C., M.Sc., M.I.C.E.

(continued from page 140)

Takoradi, Gold Coast

The harbour at Takoradi (see Fig. 3) comes under the classification of an artificial harbour; it was opened to shipping in 1928, and is the only deep-water harbour on the Gold Coast. Two breakwaters enclose a water-area of about 220 acres and the internal development in wharfage, moorings, sheds, road and rail communications, etc., at the date of opening, was sufficient to meet trade requirements at that time.

Trade grew rapidly, however, and, by 1938, extensions were considered and planned. The war prevented their execution but, towards the end of 1946, the Government of the Gold Coast raised the whole question of harbour development at Takoradi and decided upon the extensions now in hand. These extensions have been planned to deal with the much-increased normal trade of the port and to provide for what is estimated to be the trade-increase during the next ten years. They will fully develop the area enclosed by the existing breakwaters and any future extensions may well necessitate an enlargement of the water-area by the construction of a new lee breakwater and lengthening of the existing main breakwater.

The chief works now to be constructed comprise two deep-water quays for general cargo and one for coal, built in concrete blockwork; two jetties, one for oil imports and the other for bauxite export; and 3,500 linear feet of mass-concrete quay, with shallow - to - medium water alongside for timber exports.

The bed of the harbour consists of a reddish sandstone, with fairly large patches of silt, most of which has been deposited since the rubble breakwaters were built. The depth below L.W.O.S.T. varies from 7-ft. at the inner end of the harbour to about 40-ft. at the entrance. The range of tide at springs is 5-ft. and the quay-surface-level is 10-ft. above low water.

The shallow-water-quay walls for the timber-depot are formed of 1 : 2 : 4 mass concrete with 3-in. coarse aggregate, deposited in situ, faced above the —2.00 level with similar concrete but 1-in. aggregate. These walls are founded on rock, the surface of which is levelled off and keyed to rock by a series of 2-ft.-6-in.-diameter holes, 9-in. deep, at about 6-ft. intervals.

The deep-water-quay wall for the general cargo and coal berths is constructed, up to a level of +2.00, of pre-cast-concrete blockwork of 1 : 3 : 6 mix, laid on horizontal courses, bonded and keyed. The standard-size block weighs 12½ tons. The wall superstructure is built of 1 : 2 : 4 mass concrete and faced as described for the shallow-water-quay walls. Within the superstructure, there will be a service subway, 6-ft. 3-in. by 4-ft., to carry water- and fuel-oil-pipes, cables, etc. The foundation for the block wall is of 1 : 2 : 4 mass concrete, deposited between shutters on the rock bottom, prepared as described above, and the concrete is screeded to form an even base to receive the blockwork. The foundation will be carefully stepped down where the depth of the rock calls for an additional course of blockwork.

*Paper presented to The Conference on Civil Engineering Problems in the Colonies, July 1950, and reproduced by permission of The Institution of Civil Engineers.

In the first instance, there was to be only one shed at the timber-depot to provide for the storage, pending the shipment, of sawn timber and veneers, but, owing to the rapid increase in this class of trade, a second shed was subsequently added. Each shed, 400-ft. long by 175-ft. wide, consists of ten 40-ft. bays, each bay mounting a 3-ton overhead travelling crane. The sheds overhang the quay by 25-ft. to permit direct loading into lighters and to protect the loads against rain. The sheds are served by three

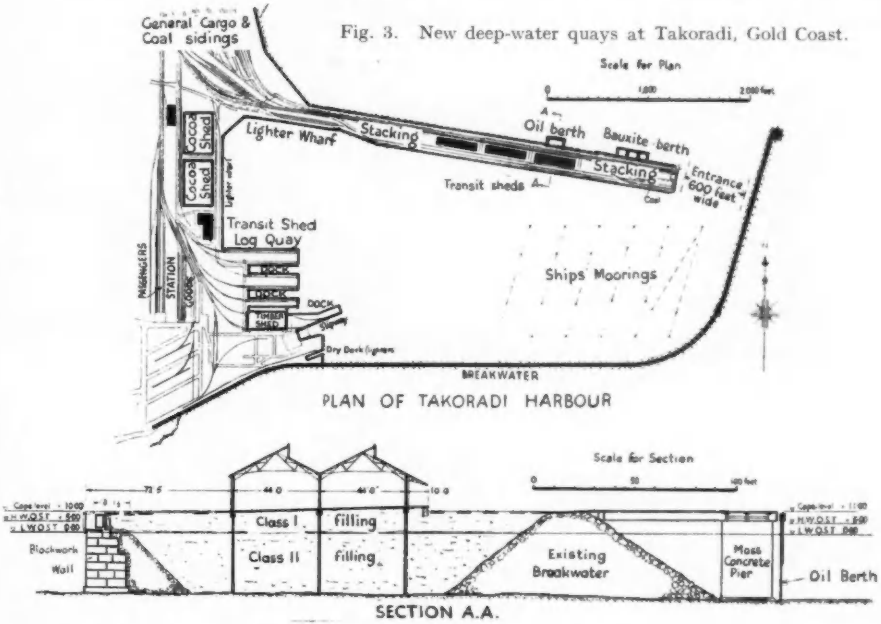


Fig. 3. New deep-water quays at Takoradi, Gold Coast.

rail-tracks, two inside for loaded wagons and one outside for clearing empties. One inside track runs 10-ft. 10-in. back from the face of the quay and is intended generally for direct loading; the second runs along the back of the shed and is mainly for loading to the storage-area. These sheds are carried on groups of four reinforced-concrete piles, driven through filling to the rock, the pile shoes having 2-in.-square ends.

The log-quays are to be served by two tracks, 6-ft. 6-in. and 22-ft. 6-in. respectively, from the face of the quay, the inner track being straddled by 7-ton portal cranes which load direct from wagons to lighters or rafts or to the storage-area behind the quay. One 15-ton portal crane is to be provided for very heavy logs.

The existing transit or general-cargo quays were originally served by two tracks, 12-ft. 6-in. and 29-ft. 6-in. back from the face, the front track being straddled by 2-ton portal cranes. The front of the transit sheds was 40-ft. back from the face of the wall. Subsequently, the Harbour Authority, to meet traffic demands, added a third track, 57-ft. back from the face; this involved narrowing the transit sheds by one bay of 44-ft., making the front of the sheds 84-ft. back from the face of the quay. For the extensions now in hand the revised arrangement described has, with minor variations, been followed. The third track is to be continued on the line 57-ft. back from the face, the new transit shed will be set back to 72-ft. 6-in. from the face, and the capacity of the portal cranes straddling the front track will be increased from 2 to 5 tons. The wide area formed by providing the third

Colonial Harbours and Wharfs—continued

track will form an open dump for handling imperishable goods in transit.

The coal-berth at the outer end of the main wharf-extension will be provided with three tracks at distances of 19-ft. 5-in., 33-ft. 7-in., and 47-ft. 9-in. respectively from the face of the quay, and these are straddled by two 5-ton. travelling gantry grab-cranes which will unload from ship direct to wagons or to a storage dump behind the quay, or recover from the dump to wagons.

The oil-tanker and bauxite loading berths are to be built on the outside of the lee breakwater, the former to replace an existing arrangement of stem-and-stern moorings at which the tanker rides stern-on to the breakwater and head to seaward; the bauxite berth will consist of an existing structure transferred from the inside to the outside of the harbour, modified and strengthened to suit the new position. Both berths are to be of the breasting-block type of jetty, well fendered and buttressed to the breakwater, and the bauxite jetty will carry loading equipment which will be fed by an aerial ropeway from an ore-dump and loading-station on shore about 1 mile away.

cast moulded concrete blocks with a flight of boatsteps at each end of the wharf, ladders at intervals of 180-ft., and cast-steel cope-bollards, spaced 60-ft. apart. A rubble bank is tipped at the back of the concrete blocks, and its rear face is blinded with crushed stone to retain the sandy filling of the reclamation.

At the inner end of the wharf, there will be a considerable reclamation area, protected by a rubble bank. This area will provide sites for coal stacks and sidings whilst, at the back of the wharf, an open store, 225-ft. deep is obtained by cutting away some high ground.

Ample provision has had to be made for surface drainage on account of the occasional heavy rainfall and the services provided on the quay include those for fresh water and fire prevention, fuel oil for bunkers, electric light and power, telegraphs and telephones, and pipe-lines for handling palm oil in bulk.

Three sheds are provided: two single-storey sheds, 300-ft. by 75-ft., and a double-storey shed, 340-ft. by 75-ft., the upper storey of the latter being used entirely for passenger, customs, commercial offices, etc. The sheds are steel-framed structures

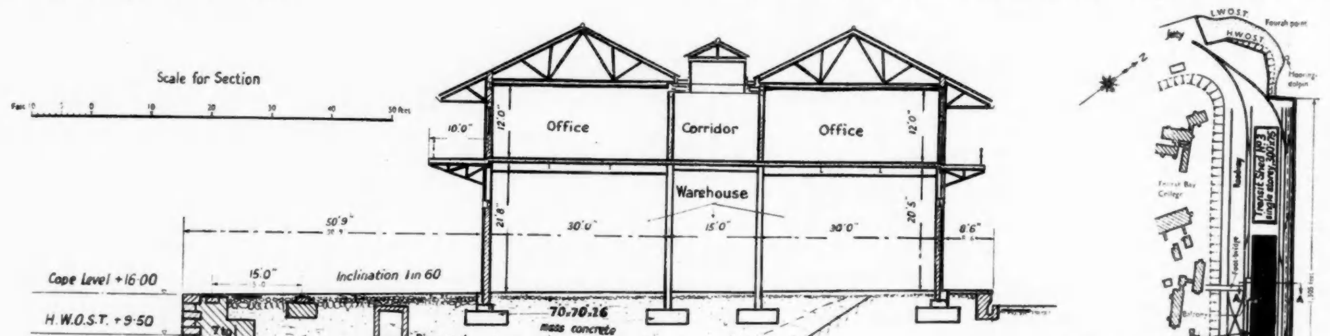


Fig. 4. Deep-water quay at Freetown, Sierra Leone.

Freetown, Sierra Leone

As previously mentioned, a deep-water wharf was commenced before the 1914-18 war at Freetown, Sierra Leone, but hostilities stopped the construction. The scheme, with a slightly greater depth of water alongside, was revived after that war but, since the cost would have increased from about £170,000 to £370,000 the whole project was abandoned after £70,000 had been expended on preliminaries. The original design was for a wharf 90-ft. long, to have been constructed departmentally by direct labour. The wharf wall now under construction (see Fig. 4) is 1,200-ft. long, with a depth of 32-ft. below low water sufficient for two large vessels and a smaller coasting vessel or collier. The foundations available in this case are firm sand and clay mixed with laterite boulders, which afford a good bed for a layer of 4 : 1 mass concrete, deposited under water which varies from a depth of 18-ins. at the front to 3-ft. at the back, with the bed of the prepared foundations sloped to this extent. The top of the concrete is screeded off level by divers to receive the superimposed blocks. The pre-cast 7 : 1 concrete blocks, the largest of which does not exceed 20 tons, are set in horizontal bond, the face blocks being keyed together with concrete in bag joggles. The range of spring tides at Freetown is 9-ft. 6-in. and the coping level is 16 feet above low water, or 6-ft. 6-in. above high water spring tides. The super-structure is formed of 7 : 1 mass concrete, faced with 4 : 1 pre-

with columns, stringers, lintels, etc., cased in 4 : 1 fine concrete. The accommodation on the upper floor is somewhat similar to that provided for the passenger shed at Lagos and provision has been made for offices for commercial firms, as may be required. This upper floor is reached by stairways at each end of the shed, a double central staircase, and a lift, and shore communication with the high ground in the rear of the wharf and with a car park is effected by a footbridge over the reclamation. Smaller sheds are to be erected for stores, fire prevention apparatus, etc., and a weighbridge will be installed.

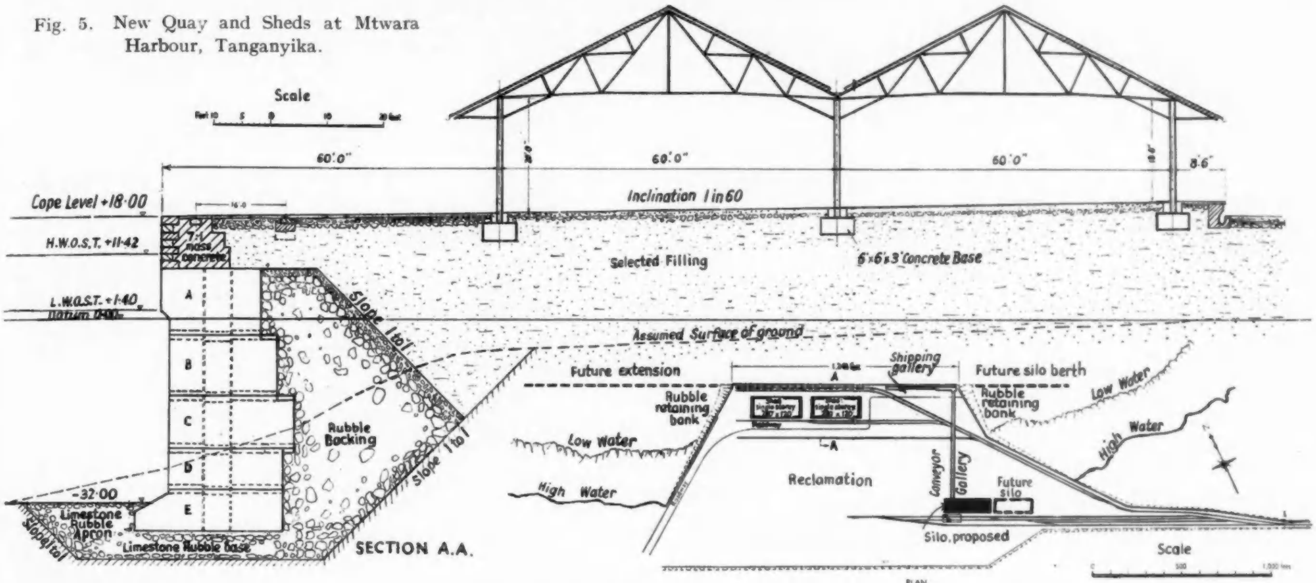
Provision is made on the quay for one 5-ton and two 3-ton electric portal cranes running on 15-ft. gauge rail tracks. Three lines of 2-ft. 6-in. gauge railway will be laid in front of the sheds and two at the back together with other lines and sidings as may be required by the railway authorities. Road access is obtained by an inclined cutting through the cliff and high ground at the back of the wharf.

Mtwara Harbour, Tanganyika

At Mtwara, in the southern province of Tanganyika, there is a land-locked harbour with an area of 3¼ square miles at low water; of this area 2½ square miles has a depth of more than 5 fathoms. The entrance channel, which is about 2 miles long, runs due north and south, so that early morning or evening sun does not affect navigation the navigable width is about 1,000-ft., the depth

Colonial Harbours and Wharfs—*continued*

Fig. 5. New Quay and Sheds at Mtwara Harbour, Tanganyika.



varies from about 24 to 13 fathoms, and the range of spring tides is 10-ft. The foundations at the site of the wharf, as disclosed by borings, consist of coral, sand, and decomposed coral, which is dredged to a depth of not less than 42-ft. below low water. A blockwork quay wall is founded on a bed of limestone rubble, the top of which is blinded with crushed stone. The wharf now under construction (see Fig. 5) is 1,250-ft. in length and is built of 6 : 1 concrete blocks set in sloping bond, the weight of each block being 50 tons. When tenders were invited for this work, in May 1947, the contractors were given the option of constructing blocks heavier than the 15-ton blocks shown on the tender drawings, in order to suit the plant they proposed to use, and the successful contractor adopted this larger size of block at his own request. There are five blocks in each slice of wall and these remain on the block-yard floor until required for setting, when they are conveyed to a slipway, picked up by floating plant, and set in position in the wall. The slices are bounded to each other by a 4-ft. 6-in. by 4-in. tongue and groove extending for the full height of the block-work. The superstructure is 6 : 1 mass concrete, faced with 4 : 1 moulded concrete blocks with the coping level 18-ft. above low water; the depth of water alongside is 32-ft. at low water spring tides and the foundations are protected by a rubber apron extending about 25-ft. from the face-line of the wall.

The wall is backed for the full height of the blockwork with limestone rubble, the rear slop of which is sealed with a coating of fine rubble.

The ground at the back of the foreshore rises slightly and is excavated to supply filling for the reclamation of the foreshore. The area to be excavated and reclaimed is about 46 acres in extent, and railway sidings, sheds, and other port facilities will be established upon it.

Two single-storey sheds, each 280-ft. by 120-ft., are to be erected on that portion of the wharf, earmarked for general import cargoes. The other part of the wharf will be for the export of groundnuts in bulk and provision for bulk loading has been made.

The services provided on the quay consist of a track for portal cranes, two lines of metre gauge railway in front of the sheds and one line at the back, fresh water and fire prevention, electric light and power supplies, and mains for bunker oil and diesel oil.

The usual provisions are made for cope-bollards, boat-steps, ladders, etc., and also for hanging floating fenders.

The development of southern Tanganyika will undoubtedly result in extension of the harbour facilities, but this may take some years. The territory, however, is fortunate in possessing a fine sheltered harbour, at Mtwara, capable of almost unlimited expansion.

Castries Harbour, St. Lucia

The quay wall at Castries Harbour (see Fig. 6) in the island of St. Lucia, in the West Indies, was built between 1886 and 1888 from the designs and under the direction of the late Sir John Coode, K.C.M.G., Past-President I.C.E. The wall is 650-ft. long and consists of two rows of pre-cast concrete cylinders, sunk as close together as possible and filled with mass concrete hearting. The cylinders or columns are 6-ft. 6-in. in diameter, with walls 15-in. thick, leaving 4-ft. diameter wells which are filled with mass concrete. They were formed of eight 5-ft. long sections which, when toothed together, made a vertical column, 40-ft. high, which could be extended if the foundations so required. The overall thickness of the wall thus produced was about 12-ft. 6-in. and the back was sealed by a timber pile driven in each re-entrant angle of the back row of columns, to prevent the filling seeping through. The cylinders were sunk by grab through mud, sand, and clay to a depth of 12-ft. below the dredged level. Since there was no rubble backing immediately behind the columns, the reclaimed area was filled with dredgings obtained from the bed of the harbour, the harder or better-class dredgings being deposited immediately behind the wall. The superstructure of the wall was formed of mass concrete with vertical greenheart fenders, at intervals of

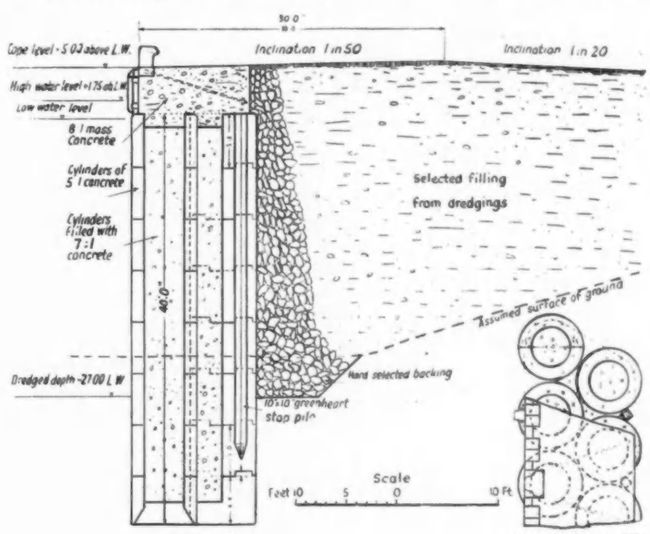


Fig. 6. Quay Wall at Castries Harbour, St. Lucia, West Indies.

Colonial Harbours and Wharfs—continued

13-ft. 4-in., and cast-iron cope-bollards, spaced at 66-ft. centres. The coping level is 5-ft. above low water level and, since the range of tide is 21-in., the quay is only 3-ft. 3-in. above high water level. The bed alongside was dredged to 27-ft. below low water, so that the wharf could accommodate ocean-going vessels of the draught prevalent at the end of last century.

The cross-section of the wall is interesting and rather unusual, in that it consists of jointed columns without any reinforcement, such as old rails, in the hearting of the wells, to assist in the tying together of the pre-cast sections of each column. The columns are united only at the top by the mass concrete superstructure which is keyed 12in. into each wall. The cross-section shown in Fig. 6, might give the impression that the wall is insufficiently robust to stand up to its work, yet, after 60 years of constant use, a recent report upon the conditions of the wharf states that the only repairs that have been necessary were to the fenders and that the wall seems to have been adequate for the purpose for which it was designed. In view of the fact that the island is subject to occasional earthquakes it is gratifying to learn that no cracks have appeared in the structure.

(The Discussion on this Paper will follow in the November issue).

Correspondence

To the Editor of *The Dock and Harbour Authority.*

Dear Sir,

Model Studies of Apra Harbour

Thank you for sending me copies of your Journal containing a review of the above study. I certainly am very pleased with the way it has been handled. Our report had, as its primary objective, the making of specific recommendations on design and construction features of the harbour. For the benefit of the general reader, your Reviewer has cleverly rearranged the report in such a way that it emphasises the physical aspects of the problem and the methods and procedures used in the model study to investigate these various aspects. I was particularly impressed with the careful and clear manner in which he presented the justification for each of the principal steps in the model study. This is a most important point. In my opinion, one of the major liabilities of hydraulic model studies is that practically all models, whether good or bad, present a very convincing appearance. This means that through the old principle of "seeing is believing," it is easy to convince a client, and even unwary technicians, that unsound model results are valid. Thus, the laboratory staff must assume the responsibility of making sure that the operation of the model is sound and that all of the essential features of the phenomenon under study are represented correctly.

Another point that impressed me with your review is the fact that attention was drawn to the significance of the investigation of alternate harbour entrances. To my mind, this little tangential investigation illustrated quite clearly the need for more careful consideration in the location of harbour entrances. In the case of Apra Harbour, the extreme depth of the natural entrance probably made it impractical to consider any of the alternate locations. However, in general, a choice of entrance is possible in the early development stages. You might be interested to know that one of the current laboratory projects, also sponsored by the Bureau of Yards and Docks, is a study of general harbour design features, which is concerned with just such questions as this.

Sincerely yours,

California Institute of Technology, ROBERT T. KNAPP,
Pasadena. Professor of Hydraulic Engineering.

17th Sept., 1951.

"Gneisenau" Reported Raised.

According to a Polish news agency report, the German battle cruiser "Gneisenau" has been raised in the Port of Gdynia, where she was sunk at the end of the war. The raising of the ship will clear the main entrance to Gdynia harbour, and is also expected to provide about 20,000 tons of scrap steel and other ferrous metals from the hull alone.

Mechanical Handling in Australia

The Operations of the Commonwealth Handling Equipment Pool

By W. MAHONEY, Technical Officer

The arrival of U.S. forces in Australia during World War II not only provided us with that extra combat strength so necessary for the successful conclusion to hostilities, but also brought fleets of modern handling equipment and the knowledge of new methods of handling for the purpose of speeding up the movement of supplies.

Fork trucks, towmotors and modern cranes were engaged on wharves, materials were palletised in unit loads and, by using fork trucks, were picked up and stacked in one or two lots by one man, with the result that materials were moved more expeditiously and the number of personnel required for Base operations was reduced. Warehouses were stacked to their roofs by fork trucks, increasing storage capacity at a time when every cubic foot of space counted; highway vehicles were loaded and unloaded by mechanical means, reducing the waiting time at terminals; and more efficient stevedoring was achieved. The cumulative result was the attainment of the prime objective, namely, the speedier turn-round and more economic use of available merchant shipping.

The advantages attained by the use of these new methods of handling were quickly appreciated by the Australian authorities and a number of fork trucks was procured from the U.S. to help speed up our own war effort.

It was also realised that this type of equipment was not new to American industry, but had been in operation for many years and had contributed considerably towards the build-up of production by keeping handling costs to a minimum.

Acknowledging the economic value of these methods, the Commonwealth Government arranged to acquire all surplus American handling equipment located in Australia and the Islands at the conclusion of the war. It was planned to form a Pool from which the shipping and related industries could hire equipment as required and receive technical advice on handling problems. To carry out these functions, the Commonwealth Handling Equipment Pool was established.

The result was very gratifying. Branches of the Commonwealth Handling Equipment Pool were opened at Sydney, Brisbane and Melbourne, the principal ports of the Commonwealth, with agencies at Hobart, Launceston, Devonport and Burnie in Tasmania, and at Fremantle in West Australia. Later, the Pool's activities extended to other important ports, namely, Darwin in the Northern Territory, and Cairns, Townsville, Rockhampton and Gladstone in Queensland.

In order that equipment could be suitably distributed and used to the best advantage, it was decided to introduce the mechanical handling principles to the spheres of Transport and Production, so that by co-ordinating the movements of these sections of industry, a smooth flow of raw materials and commodities would be assured. To give effect to this plan, specialists trained in all phases of materials handling were selected to make contact with and educate shipping and ancillary organisations on materials handling problems.

Unit loading has now been substituted extensively for individual manual handling. In some instances, where machinery has been substituted for manual handling, output has been increased by over 40 per cent., the labour gained being transferred to direct production.

In most industrial centres throughout Australia there is a shortage of storage space. The heavy demands on the limited supply of materials and labour available have curtailed severely the construction of additional warehouses, consequently every cubic foot of existing storage must be fully utilised. By using Pool equipment this has been accomplished to a marked degree.

In some instances higher stacking has resulted in a gain of 200 per cent. in warehouse capacity.

In increasing numbers, transport organisations are adopting the movement of goods on pallets. It has been realised that unnecessary time spent at terminals by transport units is uneconomical

Mechanical Handling in Australia—continued

and that the loading or unloading of vehicles is considerably expedited by carrying unit loads which can be handled by fork trucks. The benefits to be derived by such transportation methods are reflected at the ports. Where highway transports carry palletised loading there is seldom congestion. Fork trucks supplied to the shipping companies by the Pool rapidly load or unload the vehicles and stack the materials roof high in the wharf sheds or directly under the ship's hook, and considerable labour saving results.

The prompt turn-round of shipping is one of Australia's main problems to-day. A shortage of labour, labour troubles, a 40-hour working week and fluctuations in shipping traffic, more particularly where seasonal factors operate, are some of the causes of port congestion. It is claimed that, by maintaining a large fleet of handling equipment, the Commonwealth Handling Equipment Pool is assisting to overcome the difficulties of wharf congestion and the slow turn-round of vessels.

The fork trucks and light cranes working on the wharves of the Australian waterfront are operated by members of the Waterside Workers' Federation and, in most cases, these men do a most satisfactory job of work. The operators are trained by Pool instructors, not only to drive the machines, but to use them intelligently. At time, however, full use of the equipment is restricted by the application of the regulations and customs of their union.

To demonstrate what could be accomplished by the full use of pallets and fork trucks, a palletised cargo of Army Stores was loaded into the ship, "George K. Fitch," at Sydney. The whole operation was thoroughly organised; road transport was timed and controlled according to a schedule; the layout of materials in the wharf sheds was planned; fork truck operators were detailed for their particular duties, some to receive, others to transfer loads from shed to ship's hook in conjunction with towmotors and trailers. The complete operation worked smoothly and 10,000 tons of palletised cargo was loaded in 10 days. The "River Fitzroy" was loaded in a similar manner and it was estimated that 10 days were saved in turn-round time. In both the instances quoted, the stowage was carried out manually, pallets being returned to the wharf.

During the war, many vessels carrying American supplies were stowed with palletised loads, but shipowners do not consider this method of loading to be economical for commercial purposes. Efforts have been made by the Pool's technical staff to produce an expendable pallet constructed of cardboard or a similar material, of less bulk and lower cost than the standard pallet. Similar pallets are in use in U.S.A., but local manufacturing charges are too high and the adoption of a similar practice is therefore not possible at present in the Commonwealth. However, many shippers are using the system of palletising from factory to ship's hold, where the goods are then manually stowed.

It has been realised that this method of handling save much time and practically eliminate spoilage. A recent shipment of 10,000 tons of cement packed in paper bags and placed on pallets show less than one bag per 500 to be spoiled during the movement from works to the wharves.

The handling of bagged flour on pallets is becoming increasingly popular and a shipment of 8,000 tons palletised at the mill and handled by the Pool's fork trucks at the wharves, speeded up the turn-round of the ship and reduced handling charges.

At times cargo is received from overseas which has been stowed by fork truck in such a way that the only safe method of unloading this material is by placing a fork truck in the hold. To make this operation possible and to comply with the fire risk regulations of the Navigation Act, the Pool has purchased a fleet of battery-operated fork trucks. It is anticipated that these machines will not only be used for the purpose already mentioned, but also for handling bulk cargo, palletised materials and heavy packages from the ship's hook to the wings of the hold and vice-versa.

It will be realised that to introduce new systems of handling on the waterfront where older methods and customs have prevailed for years is a slow process. Experience has proved, however, that shipping companies, stevedores, industry generally and labour are accepting the fact that mechanical handling is to the advantage of all concerned and that, to keep abreast with development, sooner or later these modern methods of cargo handling will become common practice throughout Australian ports.

If production is to be increased or even maintained, industry must have an adequate supply of coal. For the past few years, coal production in Australia has not been equal to the demand. This situation has arisen from various causes, including the rapid expansion of industry, increasing population and labour troubles in the mines. In an endeavour to increase production, the coal authorities decided to exploit open cut mining. Here again, the Commonwealth Handling Equipment Pool co-operated. Included in the Pool's fleet of cranes were larger crawler units fitted with draglines and buckets and having lifting capacities of up to 20 tons. These machines were operated in the open cuts, and their use was responsible for an increase in the coal output of several thousand tons per week.

The Commonwealth Handling Equipment Pool is administered by the Commonwealth Department of Shipping and Transport, and is a self-supporting organisation which trades with the public in much the same way as a private commercial undertaking.

Equipment available for hire includes some hundreds of fork trucks with complementary attachments, three- to five-ton mobile cranes, self-propelled and truck-mounted 10-ton mobile units, crawler cranes, straddle trucks, towmotors, conveyors, trailers and flat-tops, together with some 80,000 pallets. In all, the Pool comprises 800 pieces of handling equipment, the excess of which over current waterfront demands is available for hire by the general public and by government departments. It is interesting to note that waterfront demands for the equipment have increased from 174,872 hiring hours in 1948/49 to 351,706 hiring hours in 1950/51.

Use of the Pool's handling equipment has prompted many other organisations throughout Australia to purchase their own equipment and it has been the policy of the Pool to encourage these purchases where it is considered that the expenditure is warranted. These operate permanently in factories, warehouses, goods yards and on the waterfront The Pool's equipment, in those instances, serves as a reserve which may be drawn upon to supplement the privately-owned equipment at peak periods or to replace the latter when breakdowns occur.

The Commonwealth Handling Equipment Pool, with its vast fleet of equipment, is accomplishing an excellent peacetime task and would undoubtedly become, with its trained personnel, an indispensable asset in times of national emergency.

Free Zone for Panama.

A foreign trade zone, claimed to be the first in Latin America, is shortly to be established at Colon, the Atlantic entrance to the Panama Canal. It is expected that the creation of this new free port will mean lower shipping charges to many South American and Caribbean ports, with a corresponding reduction in the cost of goods. Plans for the opening of the zone are stated to be nearly completed.

Proposed Improvements at Newcastle-upon-Tyne.

It is announced that two new coal shipping staiths are to be built by the Tyne Improvement Commissioners at Whitehill Point to accommodate vessels drawing up to 30-ft. One of the staiths will be on the site of the former No. 2 staith which was destroyed by fire in 1938, and the other will be partly on the site of the present Nos. 1 and 2a Staiths which will be demolished before the work is completed. The new works are estimated to cost £600,000 and will provide up to date facilities for the shipment of coal from the Collieries in South Northumberland. Each staith will be equipped with two radial arm loaders enabling two holds of a vessel to be filled simultaneously and give quick despatch. Wagon tipplers will be provided to enable washed small coal to be rapidly shipped. The coal will be conveyed by electric conveyor belts from hoppers under the wagon tipplers to the radial arm loaders, and additional standage sidings for wagons are also to be constructed. The consent of the Treasury and Ministry of Transport is necessary before the work can commence.

Port Working in the United Kingdom

Third Instalment of a Series of Three Articles contributed for the New Education Scheme for Port Workers

(By a Special Correspondent)

This, the third instalment of a series of three articles being published in this Journal in connection with the new "Education Scheme for Port Workers" will complete Part 2 "Port Working." Last month's issue dealt with sub-headings 1—4, and in this issue, subjects 5—8 are dealt with in the order given, viz.:

5. Equipment and appliances. Passenger traffic working.
6. History of dock labour from the beginning of Trade Union organisation in 1887.
7. Port labour and methods of payment. The constitution and functions of the National Dock Labour Board.
8. Industrial relations.

5. Equipment and Appliances. Passenger Traffic Working.

Variations in equipment and the types of appliances for cargo handling in the ports of the U.K. are legion. Two main categories of cargo handling equipment, viz.: the masts, derricks, samson posts and winches carried on ships as part of their deck fittings, and the equipment on shore for use on quays, jetties, wharves, etc.

All cargo vessels except some coastwise colliers are equipped with the gear for loading and discharging themselves, so that if lying at a port or in a roadstead where there is little or no cargo handling equipment of any kind, they are able to load or discharge independently of any shore-based plant. Often costs of hiring quay cranes and port appliances are high, or ships' equipment may have greater lifting capacity than the normal quay crane; a ship's derrick to handle 10 tons is now fairly common, but a 10-ton quay crane is not. The "Liberty" type ships have heavy derricks fitted as standard (30 tons capacity is common) enabling them to deal with a "heavy lift." For lifts of 40 tons and over, a floating crane is normally used.

Ships' cargo handling gear is additional weight for the vessel (reducing her deadweight cargo carrying capacity) and costs money to maintain, so on the grounds of cheapness and efficiency the shipowner wishes to use his ships' gear for handling purposes, whenever possible, but some ports in the U.K. only allow this by special permission.

Ships' cargo handling gear uses the vessels' masts fitted with two or four derricks (or booms), sometimes of varying capacities to each, and so arranged that the "heels" or bottom ends of each derrick pivots on its own bracket (known as a "gooseneck") carried on the mast itself, a few feet from the deck level. The free end of the derrick is supported by a wire rope purchase (known as a "topping lift tackle") or a single wire (if a light derrick) secured to the derrick head known as a "topping lift span." One block of this tackle is secured to an eyeplate and link fitting on the upper side of the derrick head, or if a single wire the end thimble is shackled on. Another block (multiple if a tackle, single if a span) is carried on a heavy fitting known as a crosstree (or "table") at the top of the mainmast. The free end from tackle or span after passing through the crosstree block is carried down through suitable "lead blocks" to a winch drum, or if a single span to a smaller topping lift tackle, the lowermost block of which is fast to an eyeplate on the ship's deck.

The underside of the derrick head carries the "head block" through which passes a "runner," the free end of which carries the cargo hook. The other end is lead down the length of the derrick to a block hung on the "gooseneck" known as the "heel block." From the "heel block" the "runner" passes to a separate winch drum to that of the wire from the "topping lift tackle."

For a "heavy derrick" or "jumbo" which is normally fitted to plumb the main hold of the ship, the "fall" may consist of a "purchase" tackle, the lowermost block carrying the lifting hook, the upper block shackled to the underside of the derrick head. The free end of the wire is led from the upper block through a "heel block" to the winch drum.

The heavy derrick would have "guys" secured to each side of the head, rigged at their lower ends with purchases so that it coud be moved by winches from side to side or steadied as necessary.

A large vessel having good-sized hatches and only one or two masts would be fitted with "samson posts," stiff vertical posts shorter than the masts, usually fitted at the corners of the hatches furthest from those served by the mast derricks. Each post carries a special fitting on top equipped with eyeplates giving fastening to the topping lift blocks. Up to four derricks can be fitted to the one samson post, dependent on whether two hatches or only one has to be served. One cargo winch per derrick is standard. The whole cargo handling layout of the ship is designed to ensure that all the derrick heads can, by using the "topping lift" plumb, between them, every square foot of the hatch working area. Small coasting vessels with confined deck space may carry small deck cranes, obviating the need for cargo winches, since all gearing for hoisting, luffing and slewing motions is carried within the machinery frame of the crane itself. Generally, deck cranes are regarded as slower working, but safer than derricks and winches.

Samson posts can be fitted at the hatch square corners instead of amidships, enabling their derricks to be shorter in length and still be capable of reaching every part of the hatch square. Another advantage is that vessels proceeding through waterways with restricted head room (e.g. the Manchester Ship Canal) may have samson posts only, joined at the top by a light lattice girder fitting running athwartship carrying a light signal or aerial telescopic mast. Thus the familiar "goalpost" mast.

Winches may be steam or electrically driven, with a "low" and "high" gear, the latter for lighter loads. Each drive has its advantages.

Bulk cargo vessels with self unloading equipment are not popular in this country, although large vessels of this class are common on the Great Lakes of America, cargoes of coal, iron ore etc. being quickly dealt with. The oil or molasses tanker has its own pumping equipment, mainly designed to deal with the trimming of the cargo from tank to tank as discharge or loading proceeds. Some U.K. cement companies have been experimenting with small bulk cement carrying vessels fitted with apparatus enabling them to discharge themselves, but such ideas are slow to catch on.

From the point of view of economical operation it is considered far better in the U.K. to place bulk cargo handling equipment on shore rather than on ship where its weight may be a continous loss to the vessel's deadweight carrying capacity. Quay equipment fitted to deal with bulk cargoes must be extremely efficient, a quick turnround being a necessity. As has been stated, most bulk cargoes move in vessels in the tramp shipping trade under a charter party agreement, one of the clauses of which usually provides for a daily payment of what is called "despatch money" to the charterer, if the vessel is unloaded in port in less time than is laid down in the agreement, or for "demurrage" a daily payment by the charterer for every day's delay in discharge or loading over the agreed period. The charterer is usually anxious to earn his "despatch money," and presses port and dock authorities to keep their specialised quays up to date and fully efficient.

Considerable differences of opinion exist even in the U.K. as to the best layout and equipment for general cargo working quays. Planning port equipment demands a close study of the type and degree of preponderance of the various cargoes to be handled, with

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close estimates of the tonnages that will move from or to rail, barge or road.

Imports have to be distributed to innumerable consignees and it is not possible to do any sorting in the holds of vessels since the various items are often all mixed up. This operation has therefore to be carried out on shore, after the goods have been landed.

The design and equipment of the quay will depend largely on the means of transport the port mainly serves and to the extent direct loading (or vice versa) from land transport to vessel is carried on. If direct loading is a commonplace, roadways and rail tracks will need to approach within reach of the ships' derricks or quay cranes. If little direct loading is done, then storage space, even if only temporary, must be provided for the greater part of the cargo.

Most U.K. ports (in common with European) favour a generous equipment of quay cranes, which are more economical in man-power than ships' derricks, but need carefully designed quays with strong foundations to carry point loadings often as high as 20 tons per corner, when the jib is fully loaded with, say 5 tons, at full outreach (say 50-70 feet). On poor soil, or in river alluvium this may mean expensive piling beneath the crane tracks to support such a loading.

The modern quay layout in the U.K. favours a deck (or "apron" as the area between the face of the wharf and the shed is sometimes called) of 60-ft. or more wide, with up-to-date quay cranes with good outreach. If more than three standard gauge railway tracks are to be provided the quay should be considerably wider. All crane and railway tracks must be recessed into the quay deck, the waterside rail track to be sufficiently close to the quay edge to enable ships' derricks to load or unload cargo direct into trucks.

Self-propelling quay portal cranes (i.e having an arched supporting structure or gantry of dimensions to span a rail track and designed to pass the largest type of wagon likely to be used beneath them) are also used at British and Continental ports. The "gauge" of the portal crane track (which is usually of heavy section rails 90 lbs. per yard and upwards) varies, but 15-ft. from centre to centre of tracks is now common although any dimension giving ample clearance at the sides for standard gauge rolling stock would suffice. The quayside rail of the crane track is placed as close as possible to the quay edge so as not to lose outreach, but allowance must be made for free and unobstructed clearance for mooring bollards, etc.

"Crossovers" to each of the rail tracks are provided at suitable points to enable wagons to be "placed" conveniently for working, with a "turnout" from the quay lines to a track (usually placed behind the quay sheds to avoid having loaded or discharged wagons remaining on the quay) leading to the "exchange siding" where the railway company officially receive and take charge of the trucks. Haulage from, and to, berth and exchange siding is normally performed at the port management's expense, by either their own locomotives, or the work may be done by the railway and the cost debited to the dock operator.

The most suitable dimensions for transit sheds must again depend largely on the quantity of export traffic to be dealt with or the volume of cargo that will need sorting, or storage pending delivery. Here again, detailed study of the cargoes to be dealt with is necessary in order to decide whether to have single or double storey sheds. Generally speaking, the modern idea inclines to a single storey shed with a length dimension of about 100 feet less than the berth it serves, and of sufficient capacity to allow 75-80 cubic feet of space for each ton of cargo expected to be stored (to include walkways, etc.). The space at the shed ends is fitted with road vehicle loading platforms, the rear length of the shed abutting a railway track with platform. The 200 or so feet between sheds of adjacent berths would be used for the connecting line from the exchange sidings to the quay rail tracks. Modern ideas favour a shed 100-150 feet wide as being most suitable for the economical use of mechanical aids.

For speedy operation the walls of the transit sheds facing the cargo berths should comprise wall lengths as short as possible with numerous doors each being immediately adjacent to the next one. Any columns inside the shed (preferably none if it can be avoided) should be placed as far apart as possible, the fewer the better in order to help truck mobility.

Door headroom must be sufficient to permit the easy passage of a large mobile crane (say 15 feet high) and the sheds should have at least 20 feet or more headroom inside to provide for stacking cargo, and have a very slight slope to the floor (say 150 to 1) sufficient for proper drainage only, in order to avoid piled cargo leaning over too much.

Smooth hard floor surfaces must be provided both to transit shed and quay deck, to be non-slipping when damp or wet. A good shed design would permit a floor loading of up to 10 cwts. per square foot of floor area, thus allowing for good piling height.

Berth lengths vary according to the length of vessels expected, and bearing in mind that the trend of shipping is now towards greater length, 500 and 600 feet is usual for an ocean-going vessel. If the berth is to be used for lighterage, it is convenient (but expensive) to have a barge length available (say 80 to 90 feet) at one end of the berth.

Some layouts have two storey transit sheds, with the upper storey stepped back so as to afford a continuous landing platform the length of the shed. The quay cranes work cargo on to the upper floor as well as on the quay deck itself.

An up-to-date berth in a U.K. port would have self-propelling electric portal cranes (ranging from 2-6 tons capacity) moving along rails sunk flush with the quay, and sufficient to provide at least one per hatch of the ships that normally use the berth. A larger crane might be included in each berth to deal with heavy lifts, but smaller capacity cranes (say up to 3 tons) can be more speedily operated.

These cranes might have a hook speed of 120 to 180 feet per minute, with level luffing motion (i.e. when the jib moves vertically to give greater or less radius, the load is not taken up or lowered as as result of the consequent taking up or paying out of the hoisting rope), which assists control and saves power. The jib would be capable of rotating through a complete circle in about $1\frac{1}{4}$ to 2 minutes (depending upon crane capacity—the lighter this is the more speedy the slewing motion). Jib outreach would vary from 50 to 70 feet depending on quay width and beam of ships. Crane equipment would include the fitting of full safety devices so that the driver cannot overwind (i.e. bring hook and load too close to the jib top sheave) or lift too heavy a weight (usually a relay fitted on the control panel trips, cutting out the motor and applying the brake automatically). A radius gauge and control device is also incorporated so that the driver cannot luff too far outwards with the loaded jib, thus rendering the crane unstable. The driver from his glass-sided cab should have an unobstructed view of the hoisting hook from ground level (or below) to the top of the jib.

A variant of the full portal crane, suitable for use where a narrow "apron" only is possible is the semi-portal, where the gantry has the usual two waterside "legs," the back pair being substituted by a girder carried over the width of the quay and terminating in bogie trucks running on a rail fixed to the shed front, which must be very strongly built to carry the weight. The crane superstructure is carried on top of this gantry close to the waterside, so as to avoid loss of outreach. The main advantage is that quays are left clear and unobstructed.

The need for a quicker turn-round of shipping during the Second World War favoured the increase of mechanical equipment. This period saw the introduction in England of the American "fork-lift truck" and the "stacker" fork lift.

The advantage of the fork-lift truck is its adaptability in moving a wide range of cargo using the tray or pallet, which can be used with ships' slings or piled on quay or in shed while still loaded with cargo, thus curtailing double handling. The pallets can be of wood or metal trays, from 4-ft. or 6-ft. long, having a double bottom, separated by cross pieces about 3-in.—4-in. thick. The prongs of the truck are inserted between the two bottoms of the pallet.

With the "stacker" fork-lift truck, export cargo can be unloaded from road vehicle to pallets, the cargo levelled off and removed to the transit shed and stowed one on top of the other. The "stacker" can raise sets 12-ft.—14-ft., allowing the pile to be built up (assuming the bottom part of the stack can sustain

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the weight). When the ship is ready to receive, the stacker removes the cargo by pallet loads from the shed, placing it on the quay within reach of the crane. The cycle of operations is reversed with an import cargo.

Considerable divergence of opinion exists as to the degree of mechanisation of cargo handling which should be embarked upon by dock authorities. Some persons (outside the dock industry) see in 100% mechanisation a cure for high port costs and slow turn rounds in this country. The main difficulty is that U.K. ports have to deal with both import and export cargoes, all variously packaged, with differing sizes and weights, and to design mechanised equipment that would work with 100% efficiency all the types offering is impossible.

All mechanical appliances have their limitations, not the least of which is the expense of efficient maintenance, and in dealing with the heterogeneous cargoes arriving at, and departing from, U.K. ports, great care has to be used to select the most suitable appliances.

Mechanical cargo handling aims at (a) cheapening output by reducing the man hours per unit of production and (b) reducing the physical strain on workers, with consequent health welfare betterment. The bottleneck now is in the hold, where the breaking out and stowing of cargo has to be done.

Machinery or plant used in the process of loading, unloading or coaling ships in U.K. docks, harbours and canals and used on wharves and quays comes under certain seections of the Factory and Workshop Act of 1901, a Section of which empowered the Secretary of State to make special regulations for Trades considered dangerous. The Docks Regulations (sometimes referred to as the "Factory Act") were made under these powers.

A new Act, passed in 1937, consolidated and amended the earlier 1901 Act, but no change in the Docks Regulations was made, beyond the addition of first-aid rules.

The Regulations have the force of law and the person or persons whose duty it is to comply with them is named in the preamble.

They deal with: (a) Derricks, winches and permanent attachments (Ring bolts, goose necks, eyeplates, cleats, etc.). These are required to be load tested and examined (as laid down in the Schedule) by a competent person before being put into use. Particulars of the test and examination must be entered on the appropriate form by the shipyard employee who carries out the test. He issues and signs the certificate thereon. Derricks must be marked with the safe working load and must be properly rigged before testing. Certain items set out in the Schedule require independent test.

An annual inspection of derricks and permanent attachments, with a thorough examination every four years has to be made. Both are normally carried out by a ship's officer, who signs the appropriate form.

Winches (whether steam or electric) must be examined by a ship's engineer every twelve months.

Cranes must be load tested and examined by a competent person before being put into use and be thoroughly examined as set out in the Schedule.

All loose gear, chains, rings, shackles, swivels, blocks, etc., must be load tested and examined (in the manner laid down in the Schedule) by a competent person. Certain of these items must have the safe working load marked thereon, with distinguishing identification marks or numbers on all. The Chief Inspector of Factories has certain powers permitting him to exempt loose gear from test and examination or to modify any of these if he considers that the same is not necessary for the safety of persons employed.

Chains, rings, hooks, shackles and swivels in general use are required to be effectively annealed (except where exempted under the Chief Inspector of Factories powers—usually owing to the size, design, material or infrequency of use of the gear item.)

This annealing must be done under the supervision of a competent person at intervals of not exceeding six months (up to half-inch) and not exceeding 12 months (larger than half-inch). This annealing period is doubled if gear is used solely with cranes or other hoisting appliances worked by hand.

Wire ropes used must be load tested by a competent person. A sample is tested to destruction and the safe working load must not exceed one-fifth of the breaking load of the sample tested. During use wire ropes must be inspected at least every three months, once every month if a single wire in the rope is broken. The rope must not be used for hoisting or lowering if in any length of eight diameters the total number of visible broken wires exceed 10% of the total, or the rope shows signs of corrosion, excessive wear or other defect.

These same regulations also lay down that safe means of access (for persons loading, unloading or coaling any ships lying at a wharf or quay) for passing to and from the ship to the shore must be provided and access to holds also, with efficient lighting for working, with fencing or covering for open hatches, except where these are in use for passage of goods or for trimming.

After a hatch is taken over by a stevedore or other person from the master or officer in charge of the ship, it is his responsibility to see that this safety regulation is complied with and it remains his until he gives written notice on the prescribed form to the master or officer in charge of the ship.

Passenger Traffic in the U.K. is handled mainly at specialised ports, all of them close to thickly populated areas, and the modern tendency favours a two-storey shed on a quay landing stage, or floating landing stage, with deep water alongside. Passengers are handled direct via covered gangways at first floor or ground floor levels, first entering large waiting rooms or halls. Customs and Immigration inspection formalities are attended to in large rooms joined by a "circulating" or "waiting" area.

The passenger on completing the formalities passes (at Southampton Ocean Terminal by escalators) through a grille to the boat train, waiting road vehicle or his own car.

At Tilbury there is a floating landing stage connected to the shore by gangways, Customs and Immigration business being carried out ashore. Passengers pass from the ship to the deck of the floating stage direct into the Customs and Immigration Hall and pass via a "grille" to the circulating area which gives direct access to boat trains, road vehicles and car parking areas.

No cranes are provided in any of the modern layouts, luggage, cars, etc., being handled by ships' gear using special equipment, with nets for baggage. Nets are used to avoid crushing or "nipping" the variously sized baggage packages during lifting. Few cargo facilities are provided at riverside landing stages or quays or passenger quays. Cars, after passing Customs inspection on the stage deck can be driven off through special access road gangways.

It is usual to provide a "customs lockup" for dutiable stores, baggage, etc.

The handling of numbers of passengers in dock areas over cargo working quays can cause much difficulty and delay. For the cargo liner landing up to 12 passengers at a dock quay there is no problem, but the large vessel landing some hundreds needs a separate berth with plenty of manœuvring room, good depth of water at all states of the tide, specially designed quay buildings with wide entrances (the single storey transit shed, probably partly loaded with import or export cargo is unsuitable), good signposting in several languages and good road and rail facilities.

6. History of Dock Labour and Decasualisation from the Beginning of Trade Union Organisation in 1887.

1887 ... **The first dockers union.**
1889 ... **The first big dock strike in London.**
Dock labour in the Port of London prior to 1908.
1911, 1912 **Dock strikes.**
1918 ... **The Triple Industrial Alliance.**
1919 ... **The "Shaw" Award.**
1920 ... **The "Roche" Report.**
1923 ... **The "Cost of Living Index" strike.**
1926 ... **The "General" Strike.**
1945 ... **The Evershed Award.**
1912 ... **The Liverpool Registration Scheme.**
1916 ... **The Port Labour Committees.**
1924 ... **First Parliamentary Bill for decasualisation of Dock Labour dropped.**

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1924, 1930, 1931 ... The "MacLean" Committees.
1931 ... Departmental Enquiry into Port Labour.
1934 ... The Unemployment Insurance Act.
1940 ... Dock Labour (Compulsory Registration) Order.
1941 ... Mersey & Clyde Schemes.
1941 ... National Dock Labour Corporation, Ltd., formed.
1946 ... The Forster Inquiry.
1947 ... The Cameron & Hetherington Inquiries.
1947 ... Dock Workers (Regulation of Employment) Order.
1947 ... The National Dock Labour Board formed.

Since practically all the improvements in dockers' pay and conditions have been due to pressure from their unions, the following brief history of their formation and growth will be of interest.

Dock labour employers, giving evidence before a Lords' Committee in 1886 on the "sweating" system, considered the casual dock labourer of that time unable to act by himself. Isolated strikes had occurred at various ports, some of them successful, but Ben Tillett, himself a docker, organised a new union for concerted action. He took part in an abortive strike at Tilbury Dock in 1886, and general discontent at the ports due to the slackness of trade that occurred after the Franco-German war made his task in London fairly easy. Union membership was small and funds were 7s. 6d. only (compare this with the £15 million odd, the total present funds of the registered Transport and General Labour Unions) when on the 12th August, 1889, an obscure local dispute in South-West India Dock spread throughout the port. The Union demanded a wage increase of one penny, making sixpence per hour, eightpence after 6 p.m., with a guarantee that no man engaged should be paid for less than four hours' work. The strikers at first numbered 2,500, but by the end of the first week they had organised processions throughout the port calling upon other port workers to join them, and practically all the labour became idle. The employers tried to break the strike with outside labour, advertising permanent employment at £1 per week, but this effort failed, due to careful picketing.

Finally, on the initiative of Cardinal Manning, who had great local prestige, and family connections with the Dock Company Directorates, a conciliation council was formed and eventually the strike was settled.

Although successful in securing higher wage rates, casual employment still obtained and only after many bitter strikes was it brought home to the dockers that wage increases which merely attracted outside trades into the dock labour group would never bring prosperity while the system remained.

The 1889 strike gave great impetus to union membership, in other ports as well as London. The National Union of Dock Labourers formed at Liverpool in 1889, had its first strike in 1890, the main object being recognition of the Union. The strike was broken after a month, by using imported labour. In 1891 in spite of this set-back, this union had 34 port branches, including Glasgow, Barrow and Belfast. During the next 10 years the unions varied in membership with alternating phases of popularity and disfavour with the men. In 1910 the Transport Workers' Federation was formed, to combine Transport Unions throughout the country, but for some years this was only partly successful.

All U.K. ports had a following of casual labour that could be drawn upon at need, its size generally fluctuating with the state of local unemployment. Casual dock labour everywhere being regarded as "unskilled" and no reference being required, the "pool" became the last resort of those for whom society had little or no use.

The system of engaging labour varied, but in London and Liverpool recognised places known as "calling on stands" near each dock were "collecting" points for the casual labourers who attended there just before the usual recognised time of commencing work. The employers' representatives (usually foremen) attended at these stands and engaged the labour they required.

The 1914-1918 war years produced the Triple Industrial Alliance (a fusion of the Transport Workers' Federation, the Miners' Federation and the National Union of Railwaymen) by which membership was greatly strengthened and the Federation had some success by securing fuller adherence. By the end of the war practically all dockers were trade unionists, although in many ports the position was weakened by rival unions competing for membership.

Organised dock labour reached its greatest triumph in October, 1919, when the claims of the Transport Workers' Federation were referred by mutual agreement under the Industrial Courts Act to a Court of Enquiry. The principal demand was a wage increase from 14s. to 16s. per day, the remainder referring to overtime rates and shift work. The Chairman was Lord Shaw of Dunfermline and Counsel represented the newly-formed National Council of Port Labour Employers. Mr. Ernest Bevin, who appeared for the Transport Workers' Federation, could say in opening that he represented the whole of the 125,000 Dock Labourers of the United Kingdom.

The Court's finding was a complete victory for the Federation, who were given their demand for increase in wages (a daily rate now replaced the former "hourly" rate) and although hours of work were not dealt with, certain reduced wage scales were fixed for the smaller ports. Certain other findings regarding decasualisation were, however, regarded as secondary.

The next year (1920) saw the final amalgamation of the Unions with Port Transport Workers as members, and the Transport and General Workers' Union with Mr. Bevin as general secretary, emerged. London in 1920 accepted voluntary registration (several of the leading ports already had a scheme working) for its port workers. A joint committee (with Mr. Justice Roche as chairman) appointed by the Minister of Labour soon after the Armistice to consider decasualisation and other matters relating to port labour had produced an excellent report and among other recommendations had strongly urged registration to "steady" the industry.

The dock strike of 1923 was a bitter disappointment to hopes that the new union would ensure industrial peace. As a result of a reduction in wages, due to a decrease in the cost of living index, unauthorised strikes occurred in London, Manchester, Hull, Grimsby, Cardiff and other ports in July, and the employers left the Union to struggle with its refractory members. The Union failed to re-assert its authority and the men gradually returned to work.

In February, 1924, a National Strike, lasting over a week in all the ports secured an advance of 2s. per day by instalments, with a promise of a further enquiry into the question of maintenance during periods of non-employment.

In 1926 the General Strike with its accompanying great upheaval occurred. For some weeks practically all organised labour including the dockers was idle, trade and industry being completely disorganised.

Decasualisation, the scheme whereby the dock industry maintains its own unemployed, was a plant of slow growth. Mr. Bevin, in evidence before Mr. Justice Roche's Committee in 1918 (repeated before Lord Shaw's Committee in 1919) urged that if it was right to levy dock dues or charges for the handling of goods to keep ports and docks up-to-date, it was just as fit and proper to levy a charge on all shipping using them to create a pool to be devoted to the maintenance of port workers when there was no employment.

In 1912, Liverpool had led the way for the big ports by introducing a registration scheme whereby all dock labourers in the port were to be registered and paid their wages weekly. Immense difficulties (including a strike due to suspicion of the scheme) were encountered, but it survived, although it did not fulfil the hopes of its founders as an instrument of decasualisation, mainly because of the continued admission of new men to the register on one pretext or another.

The 1914-1918 war caused the abandonment of the tentative and voluntary port registration schemes. In 1916 Port Labour Committees composed of port employers and labour representatives were set up in each of the larger ports, by the Board of Trade, to register bona fide dock workers in order to exempt them from compulsory military service. The Committees lapsed after the war and their registers becoming moribund.

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The Roche report of 1919 recommended voluntary registration for all London port workers and a Joint Committee, under Sir John Wimble, produced a scheme after much difficulty, for they had to decide what men should be admitted to, or removed from the register. Finally, 61,000 were registered in London, although the number employed throughout the Port on a busy day never exceeded 40,000. Such inflated figures were common to all ports on first introducing registration schemes, and resulted in the registers at most ports being closed at once, not to be re-opened for several years. Sons of dockers, registered on their fathers' nominations were the sole exceptions made.

The Shaw Report which followed in 1920 recommended that registration should be adopted by all ports large or small and that the industry should be decasualised, and in 1924 a Parliamentary Bill for the Decasualisation of Dock and Waterside Labour introduced by Mr. Ben Smith, M.P., was promoted by the then Labour Government. It was dropped, however, on the Dissolution in November, 1924.

One of the terms of settlement of the 1924 strike provided for the setting up of a committee to study port labour questions. That year had seen a New National Agreement negotiated, one clause of which stated the parties' intention to appoint a committee to develop and strengthen the registration system " and to examine the proposal for a guaranteed week . . . to give effect to the Shaw Report."

This Committee, under the chairmanship of Sir Donald Maclean, M.P., was set up in 1924 and re-affirmed in its report the value of registration and concluded that, pending the adoption of an efficient system, there was little virtue in considering the question of payment for unemployment or under-employment.

In 1930-1931 certain abuses of the Unemployment scheme prompted the Minister of Labour to set up a Departmental Committee under the same chairman as the 1924 Committee, to examine " decasualisation and the administration of the unemployment insurance scheme " and its application to port workers. They failed to agree on decasualisation, but recommended setting up a Standing Advisory Committee to inaugurate fresh registration schemes in the ports and, by 1939, voluntary registration schemes were in operation at all ports except Aberdeen and Glasgow.

In 1932 the Royal Commission on Unemployment Insurance recommended the Minister to take powers to introduce a decasualisation scheme himself for the Port Transport as well as other industries. Protracted negotiations between the Minister and the Port Employers had not produced a workable basis for the application of this Act, when, in 1939, war broke out.

The war placed an abnormal strain on the West Coast ports of the U.K., and in June, 1940, the Minister of Labour and National Service introduced the Dock Labour (Compulsory Registration Order) which required all ports to have registration schemes covering all employers and men engaged in port transport work. The schemes had to be approved by the Minister, and were eventually brought into operation for all principal ports except Glasgow.

In December, 1940, the Minister outlined a labour scheme for Merseyside (to be later adapted to Clydeside ports) whereby dock workers on the registers became a permanent labour force, with a minimum weekly wage of £4 2s. 6d. (the then existing time rate). It was to be mobile within the area, ready to perform any suitable task connected with the docks, with a reasonable amount of overtime work, and payment by results was to be introduced. This scheme came into operation in March, 1941, on Merseyside, followed a few weeks later by Clydeside.

It was later decided to secure a similar re-organisation in other large ports and the National Joint Council, at the Minister's request, prepared a draft scheme and decided that the National Dock Labour Corporation Limited should be created to administer it. Agreement was secured and on the 15th September, 1941, the new body was incorporated. The terms of the scheme were 5s. attendance money for each of the eleven half-day turns a man was available but not employed, piece working to be introduced where suitable, and one week's annual holiday with pay.

The Clyde and Mersey were known as " War Transport Ports," those administered by the new board as " Corporation " ports, and conditions of employment in both were not identical.

The Board took over the payment of wages and the individual employers sent weekly cheques to the Board for their employees' total week's wages, an additional percentage being charged to provide the Board with an Attendance Money Fund. The employers were empowered to recover the amount of this levy from shipowners and merchants.

In 1944 the Government intimated that there would be no return to casual working conditions and desired the industry to make proposals for a permanent post-war scheme for labour decasualisation. The employers thereupon produced a scheme which was, however, unacceptable to the Unions so that, ultimately, the Minister of Labour appointed Sir John Forster, K.C., to hold an enquiry before which both sides urged their claims. This enquiry recommended that :

(1) Decasualisation schemes be administered by a National Joint body through local or area boards.

(2) Port Registration Committees to be abolished and the registers controlled by the National Joint body and local boards, increases or decreases in members being ordered by the national body.

(3) Labour to be mobile within daily travelling distance, but distant transferability should wait on less difficult housing conditions.

(4) A weekly guarantee to cover minimum needs and all earnings whatever to be set against this.

The details of the guarantee were left unfixed and the Minister appointed Sir Hector Hetherington with a committee of four to examine this matter. They recommended attendance money of 5s. a turn (half a day) (it is now (1951) 6s.) with a weekly minimum of £4 7s. 6d. ordinary earnings and all overtime (except any for Saturday afternoons) to count against it. These findings were accepted although the " attendance " minimum was amended to £4 8s. with no week-end earnings to count against it.

As objections had been lodged, the Minister appointed Mr. John Cameron, K.C., to hold an Inquiry, the findings of which were embodied in the Dock Workers (Regulation of Employment) Order 1947, setting up the National Dock Labour Board immediately, which began operations at the end of June, 1947.

7. Port Labour and Methods of Payment. Function of the National Dock Labour Board.

Short history of general wage rates and hours of employment of casual dock workers since 1887. The piecework system of payment; the daywork (time) system of payment. Constitution and function of the National Dock Labour Board.

Dock workers' hours have been considerably reduced since 1887, when work started at 6.0 a.m. and lasted until 6.0 p.m. and it is recorded that even these hours involved considerable overtime. A reduction to 10-10½ hours per normal working shift was made between 1900 and 1910. Conditions varied, but the " day " and " night " division into shifts still operated, the intervals between the shifts being used for preparatory work, setting cranes, opening hatches etc.

After 1918 there was a move to introduce an 8 hour day, and in 1919 a conference of employers in certain ports, notably London and Liverpool, addressed a recommendation to the employers of dock and waterside labour in every port in Great Britain, suggesting that local negotiations should be entered into, using as a basis the introduction at each port of an 8 hour working day. This was done, and sooner or later every port fell into line. Customs authorities had pressed for this reform and by making charges for their staff forced to work a longer shift, were instrumental in urging the shorter working day upon port managements.

Wage levels in the last half century have risen considerably for the dock labourer. The standard minimum rates for dock labourers in London have changed from 5d. per hour in 1889 to 21s. per day in 1951. Wages increases had to be met as they were awarded, by increases in dock charges, tolls etc. charged to merchants and shipowners for the use of port and dock accommodation and services. After 1919 the subsistence level of dock labour compared with other employment rose considerably, which made doubly necessary the introduction of labour registration schemes

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in the ports. The higher real wage of the dockers was attracting labour from other trades.

The cost of preparing and training for special skills is recognised by the increased payments made above the normal standard rates to such specialists as grain porters, deal porters, lightermen and the other grades whose training costs the worker time and money in his early years.

Dock labour is remunerated by either one or two systems — "piecework" and "day" (or payment by time) work. Task work, that is where a particular job is allocated to one gang of men who cease work on its completion, is almost unknown in dock labour usage.

Piecework pays for a complete job done by a labour gang working as a unit. It is "payment by results." The sum paid to the gang for the work is usually calculated on schedule rates previously agreed between employers and Union representatives, tonnage dealt with by the gang at so much per ton forming the basis. The schedule rates agreed are arrived at as a result of past experience in handling the particular commodity and are agreed with Union representatives. Experience has shown that under this system more money is earned and shorter time taken on the performance of the work by each man in the gang, the payment according to the dexterity and speed shown by each member providing an incentive. Bad weather, bad or awkward stowage, or other reasons may cause a piecework bill to total a less sum than the amount due to the men under ordinary daily rates, having regard to the number of hours worked. No deductions in respect of the loss in these circumstances are made, normal daily rates being paid.

Many import cargoes are now customarily handled by the piecework system, but here the "custom of the port" comes into the picture, as in many ports the local Unions do not favour this method of payment.

Daywork bases remuneration on a time basis, being usually applied to work where the speed factor is not vital. Unusual quay or shed operations, involving mixed handling etc., might be so paid to yield data to compute rates and times if not already known, for subsequent piecework rate negotiations. Straightforward jobs are usually more economically done on a piecework basis, but here again custom has a large say.

Export cargo, with its fluctuating quantities, movement into and out of transit sheds, varying means of transport to berth and delivery to ship, is usually worked on a daywork basis.

Permanent weekly quay and warehouse operating staffs, as well as technical staffs are members of their trade unions, which are officially recognised. The men are paid the agreed Union rates for the trade, or such national wages award as is appropriate. Terms of employment are the same as those of others in their trades throughout the country, and their wage scales follow the national scales for their trades.

The National Dock Labour Board, the successor of the National Dock Labour Corporation Limited, was set up by the Dock workers (Regulation of Employment) Order of 1947.

The scheme sets out to ensure greater regularity of employment for dock workers and secure adequate numbers for the efficient performance of dock work. The Order named in an appendix the ports to which the scheme applied. Clydeside ports, Merseyside, Manchester and Preston areas which had adopted the Minsitry of Transport Dock Labour Scheme, were excepted.

The Board administers the scheme, ensures full and proper utilisation of dock labour for a speedy turnround of shipping and transit of goods, recruits and allocates registered dock workers to registered employers, keeps under review and adjusts from time to time both dock workers' and employers' registers, groups workers as required, provides for the training and welfare of dock workers (including port medical services) and levies from employers contributions to the cost of operating the scheme.

Smaller ports are grouped into areas or with a major port, and each of the largest ports constitutes an "area" in itself. Each area is administered by a local board delegated with as many as possible of the functions of the National Board, except decisions on the numbers on the register from time to time, and reductions or additions thereto.

The National Board has a Chairman, a Vice-Chairman and not less than eight or more than ten other members, appointed for a period not exceeding two years, by the Minister of Labour, after consultation with the National Joint Council for the Port Transport Industry. Of the members, four represent dock employers and four dock workers.

The area board in each port consists of equal numbers of persons representing dock employers and dock workers appointed for two years, the Chairman and Deputy Chairman, although appointed by the members, must be approved by the National Board.

These area boards function through a paid Manager, who has under him supervisory personnel (Sector Managers) at Branch offices in each port, dock, or wharf area responsible for the smooth working of the scheme there. They keep registers, allocate dock workers who are not successful in the daily morning and afternoon "free" calls in obtaining work, to employers, keep records of attendance of workers at call stands or control points, maintain records of employment, earnings, and payments under the scheme (as agent of the employer) to workers. They also have custody and stamping of insurance cards. The area board controls the allocation, administration and welfare of the local labour "pool" to which all unallocated dock workers belong.

The Board classifies workers there being a general, "all duties" grade, and others according to specialised training viz.: corn porters, lightermen etc.

Some ports have a system of "allocated workers," a number of men being allocated to a particular dock or wharf. Provided there is work, this is their first place of employment.

The Local Boards appoint appeal tribunals of not less than three nor more than five persons (members of which do not sit on the Board) from nominations by the local Joint Committee of the National Joint Council for the Port Transport Industry.

Conditions of the contract of employment provides for an annual holiday with pay (at rates and on conditions laid down by the National Joint Council) to be granted by the National Board to each daily and weekly worker, with pay on all statutory holidays.

The National Board must pay to the dock worker when full employment is not available for him, the amount he is entitled to receive under the terms of the current agreement for "attendance" pay as laid down from time to time by the National Joint Council for the Port Transport Industry. Conditions qualifying for this benefit are that the worker attended at the call stands etc. and that his attendance (or legitimate excuse) was recorded. Disciplinary powers are possessed in the case of workers becoming disentitled to payment. They can be suspended, given notice of termination of employment or summarily dismissed, their names being removed from the register. Disciplinary measures against an employer are also included. In both cases, provision is made for the right of appeal to the tribunal.

The cost of operating the scheme is met by the registered employers percentage payments (which must not exceed 25 per cent.) on gross wages paid, a reduced percentage obtaining on weekly workers wages. Payment may be made as agreed between employer and the Board.

8. Industrial Relations.

Brief historical review. The Industrial Courts Act, 1919. The National Association of Port Employers. The Workers Unions. The National Joint Council for the Port Transport Industry. Port Local Joint Committees.

Students reading the preceding sections cannot fail to draw the conclusion that, as a rule, up to 1939 labour and employer relations in the dock industry have been bad. This was largely the result of the casual system, which destroyed all feelings of responsibilty and loyalty, and fostered instead antagonism and distrust between the parties. Other reasons given were the increasing remoteness of the employer from his labour as compared with the days when master and man lived and worked together. One criticism directed against the interposition of the National Dock Labour Board between the workman and his employer is that it has intensified this feeling of remoteness since the employer drawing labour from the "pool" need not (and often does not) know the

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men he employs when he gets them. This unfortunately is a feature inseparable from the character of dock labour employment.

Immediately after the 1914-1918 war certain of the port employers combined to form an employers' association the better to deal with organised labour on labour matters, in the same way as other industries had found it necessary for combinations of employers to deal with workers' unions. The National Association of Port Employers was the employers answer to the Transport Workers Federation already alluded to.

The dock workers are nowadays represented by the Transport and General Workers' Union, the National Union of General and Municipal Workers, the National Amalgamated Stevedores and Dockers' Union and the Scottish Transport and General Workers' Union. London also has a Lightermen's Union. All these Unions (except the Lightermen's) nominate representatives to sit with nominated members of the National Association of Port Employers on a Committee known as the National Joint Council for the Port Transport Industry. This body is the representative one to meet and negotiate with Government Departments on behalf of the whole of the Port Industry of the U.K. It is also the industry's own joint arbitration court for settlement of disputes concerning wages. In the event of deadlock the matter is reported to the Minister, for decision under the Industrial Courts Act 1919.

Since so many trades are connected with dock and port working, wage negotiation and conciliation arrangements vary from port to port. Often there is a Port Local Joint Committee composed of equal numbers of employers and workmen's representatives who decide on such local rates and conditions as may be referred to them for decision. This method is of value where local knowledge of tradition and usages is required. Any dispute likely to have national repercussions is referred to the National body.

Improved Disembarkation Facilities at Holyhead

Following the introduction, in 1949, of two new motor vessels on the Irish Mail route between Holyhead and Dun Laoghaire, Eire, British Railways (London Midland Region) decided to install two electrically operated adjustable platforms at Holyhead to speed the progress of disembarking passengers. The platforms which were put into operation in June last, are adjustable over a height range of 6-ft. 9-in. and provide a level gangway at any state of the tide. Each plaform has a timber deck 10-ft. by 9-ft. 6-in., which projects 4-ft. beyond the face of the Customs building, and 12 independent steps are provided to give access from the platform to the upper floor. These steps rest, when in the lowest position, on padstones in the enclosing walls. As the platform is moved up they are picked up in succession by the moving underframe and are arranged to form a level surface continuous with the deck. The steps are held in position by guides which run in small vertical channels recessed in the staircase walls. The underframe of the platform was constructed of two 12-in. by 6-in. rolled steel beams 20-ft. 6-in. long, braced together 4-ft. apart and supported at their ends on four bronze nuts which operate on vertical square thread screws. These screws are carried on thrust bearings at their upper ends to ensure that they are always in tension under the weight of the platform. Each screw is supported between a pair of rolled steel channels which form the guides for maintaining the paltform in position horizontally. The screws are rotated uniformly by means of an arrangement of bevel gears and shafts taking power through a single worm reduction unit coupled to a 5 h.p. electric motor, the whole of the operating gear being situated on foundations below the lowest level of the platform. An electro-mechanical brake is fitted to ensure that the driving gear is brought to rest and holds the platform in any desired position level with a step. Overrun in either direction is prevented by limit switches, the mechanism being controlled from the upper deck of the Customs House by push buttons. The platforms are positioned, before the arrival of the vessel, at a level to suit the average height of the tide during the disembarkation period, and are maintained in this position until all the passengers have landed.